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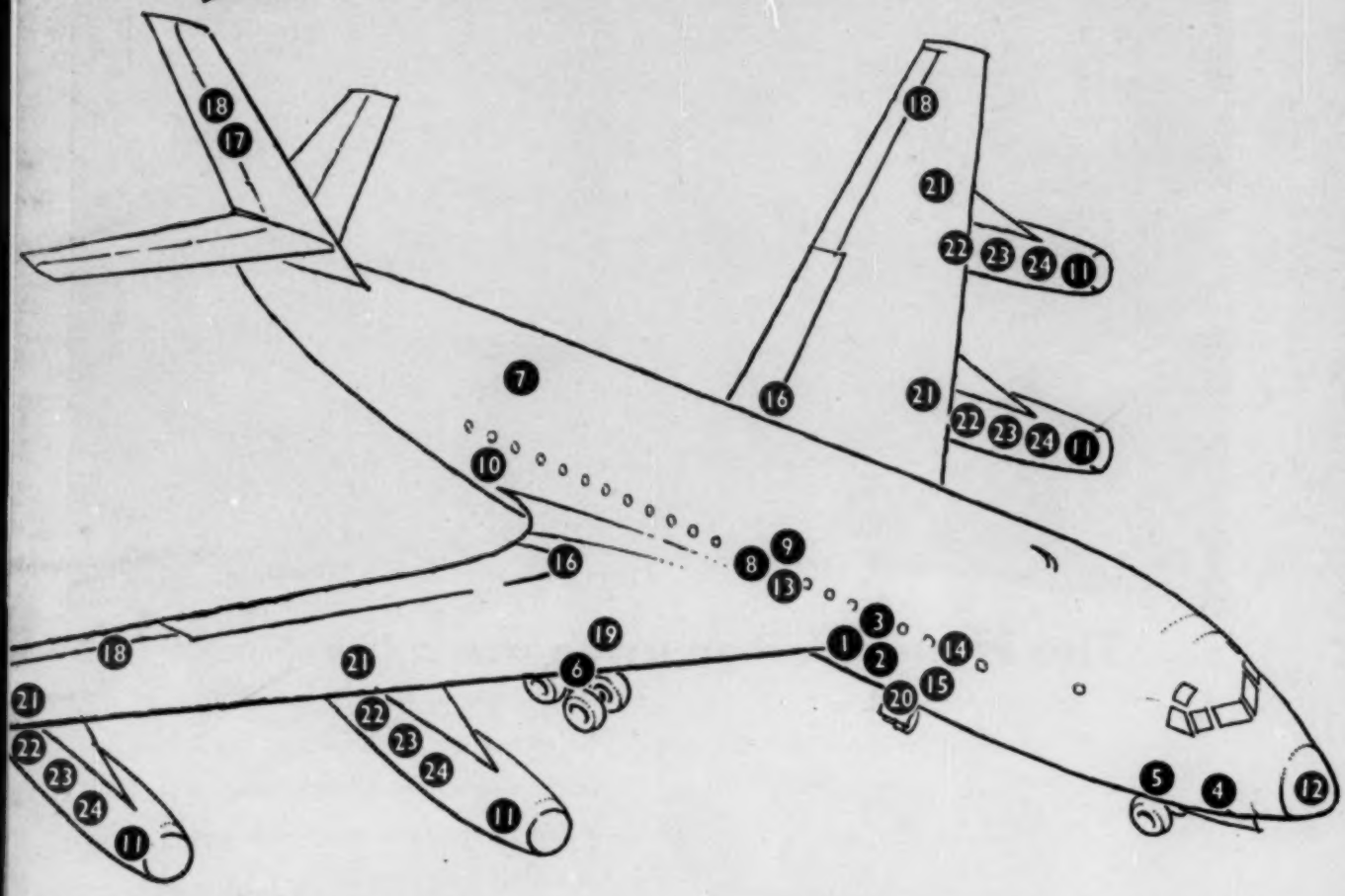

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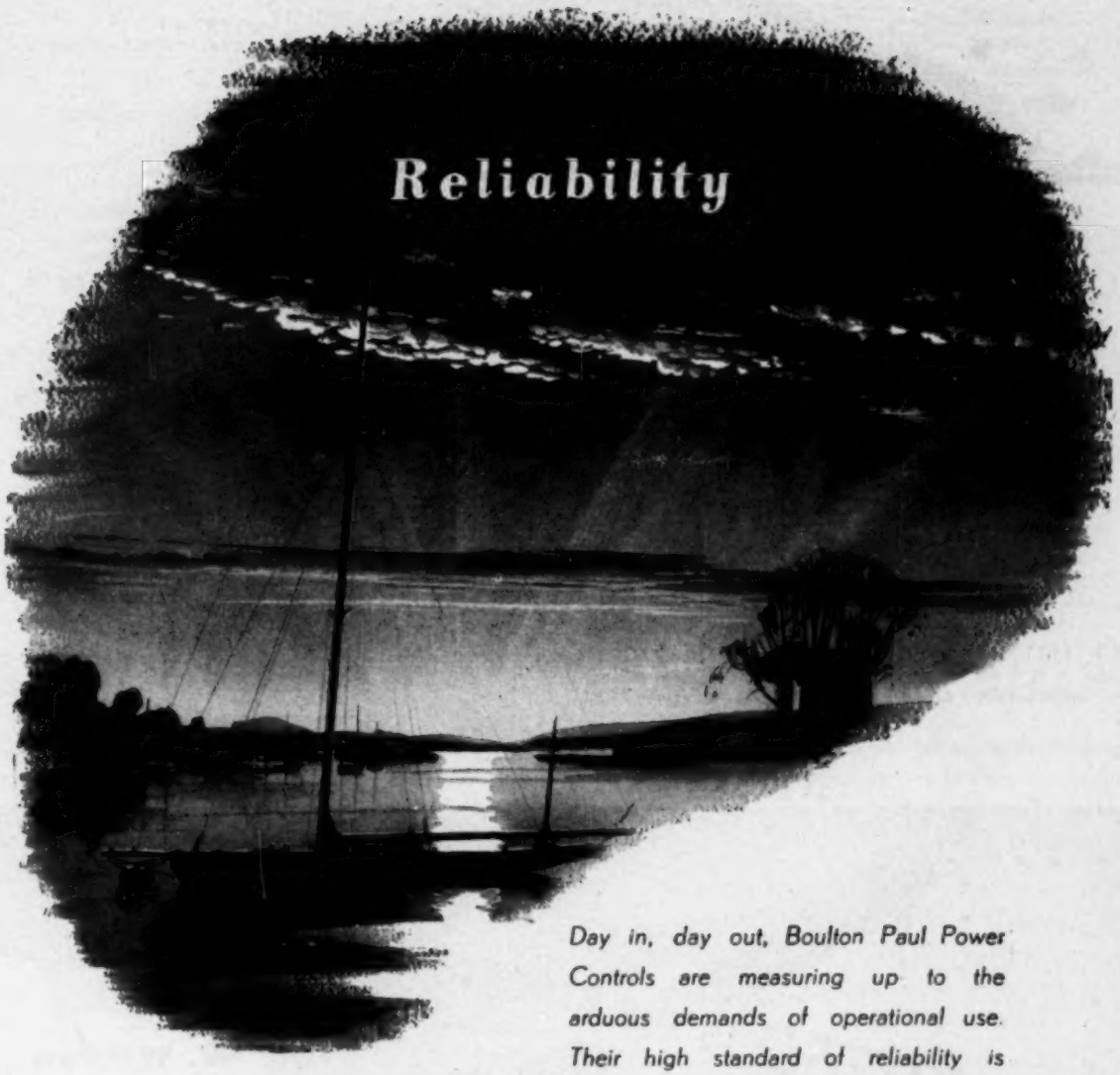

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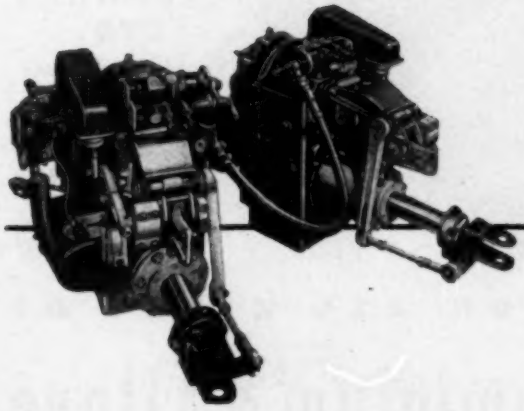

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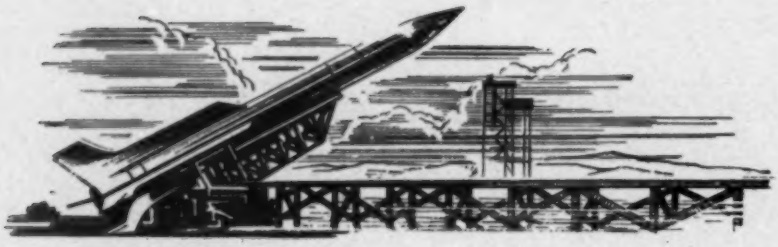

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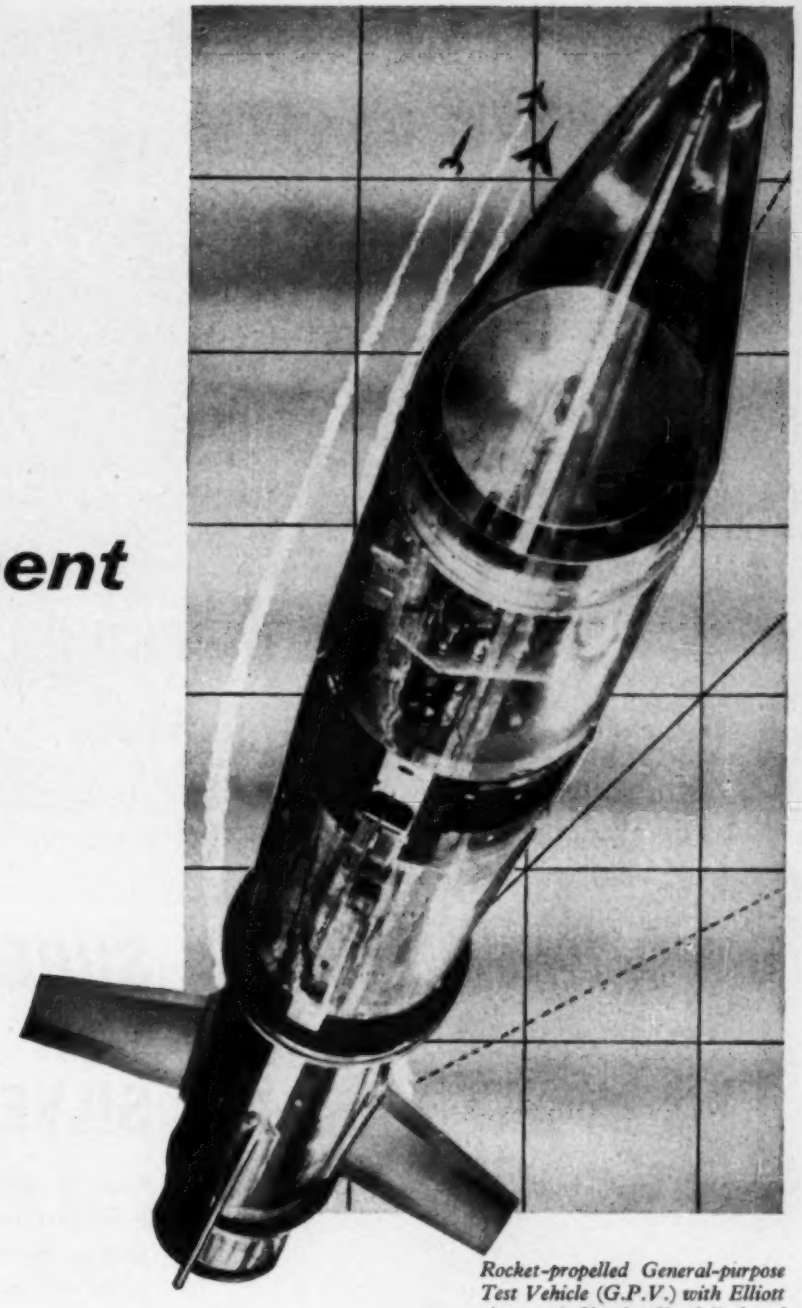

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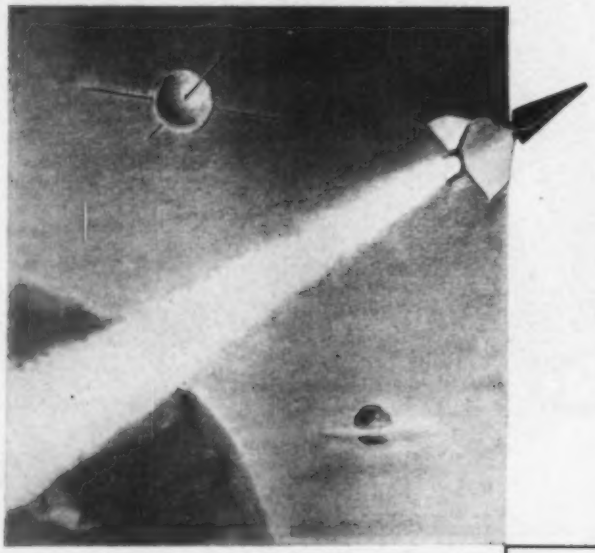

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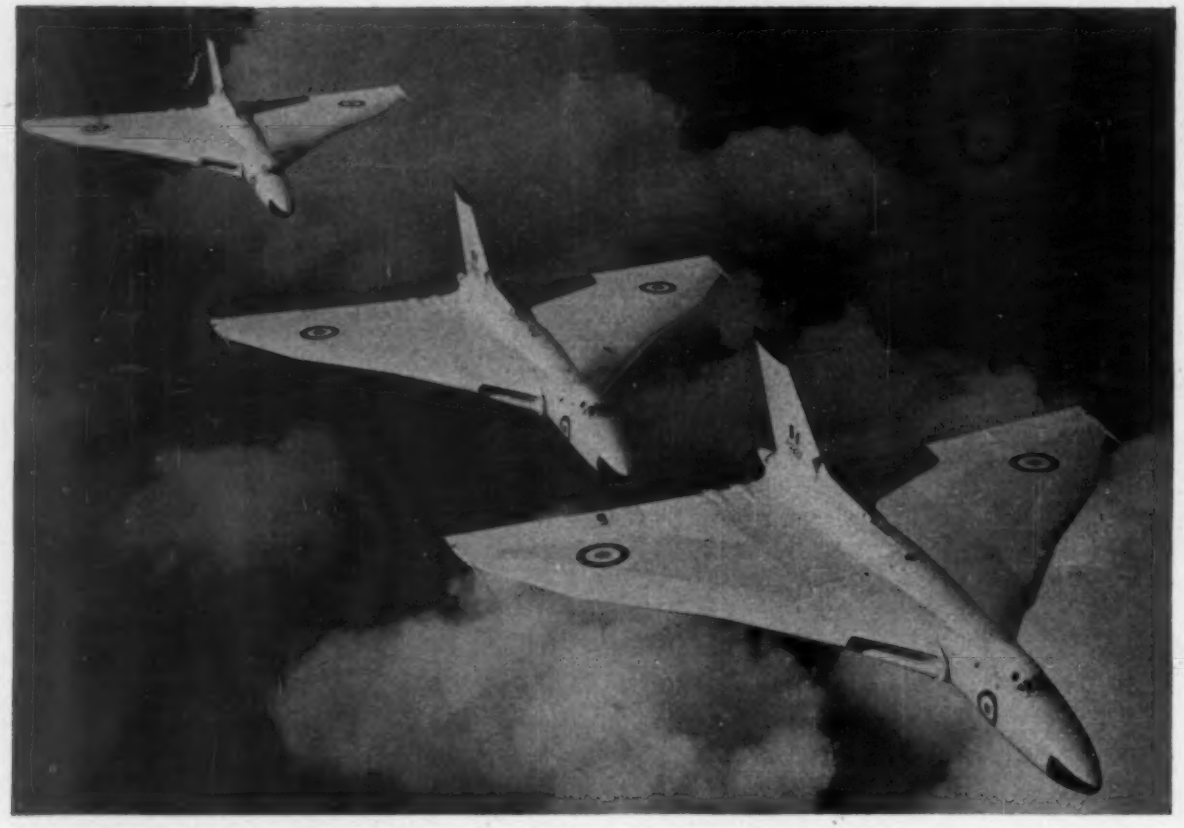

"Equal to, if not better than, any Bomber in the World"

—Mr. C. I. Orr-Ewing, Under Secretary for Air.

In announcing that the famous 617 Squadron—the Dam Busters—is to be reformed and equipped with the Avro Vulcan Delta Bomber, believed to be the fastest bomber in service anywhere, Mr. Charles Ian Orr-Ewing, Under Secretary for Air, has said that in the Vulcan "we now have a bomber aircraft which is equal to, if not better than, anything else in the world".

"The Vulcan comes from a good stable"

In addition to Mr. Orr-Ewing's tribute, the Air Officer Commanding No. 1 Group, Bomber Command, had this to say: "We are extremely pleased with the Vulcan, both from the operating and the maintenance aspects. The way in which this large aircraft and its complex system has been brought into use in the front line of Bomber Command, without any of the enforced groundings so frequently experienced with new types of aircraft, is most gratifying. The Vulcan is giving us splendid utilization; indeed, it is far better than we experienced with any other type of aircraft, large or small. The Vulcan comes from a good stable and is liked by the servicing crews as well as the flying crews."

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FIRST AERONAUTICAL WEEKLY IN THE WORLD FOUNDED 1909

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and
AIRCRAFT ENGINEER

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Armageddon—

THE news of the past week reminds us that the big question of the day is not who is to get the B.E.A. jet order, or whether the R.A.F. will have a fighter after the P.1. It is simply whether aviation will yet bring in a golden age, or whether, with atomic armament, it will prove to be the instrument of world immolation.

A recent contribution to this journal ("Dream or Nightmare?" by Maurice Allward, January 3) remarked that the war of 1939 caused an upset that had not subsided even today, and that, with the thermo-nuclear bomb, man not only had a weapon representing a gain in destructive power many, many times that of anything previous, but a weapon of quite a new kind. From which it could be inferred that the atomic bomb burst upon the world as something as novel as it was horrible. If only mankind had been warned (the argument might follow) something could have been done. World War 2 might never have occurred. The appalling problems confronting the nations could have been faced in years of comparative tranquillity, free from the hysteria and fears that now bedevil the councils of man (insofar as these exist!).

All of which would be sheer deception. The world was indeed warned of what bombers—bombers with atomic armament—could wreak upon the great cities. It was warned not during World War 2; not between the wars; nor even during the First World War. It was warned *before the war of 1914 had come to pass;* and the warning was in terms which, had they been heeded, would have chilled the heated blood of conflicting nations:—

"Certainly it seems now that nothing could have been more obvious to the people of the earlier twentieth century than the rapidity with which war was becoming impossible. And as certainly they did not see it. They did not see it until the atomic bombs burst in their fumbling hands . . ." And these: "By the spring of 1959 from nearly two hundred centres . . . roared the unquenchable crimson conflagrations of the atomic bombs. . . . Most of the capital cities of the world were burning; millions of people had already perished, and over great areas government was at an end . . ."

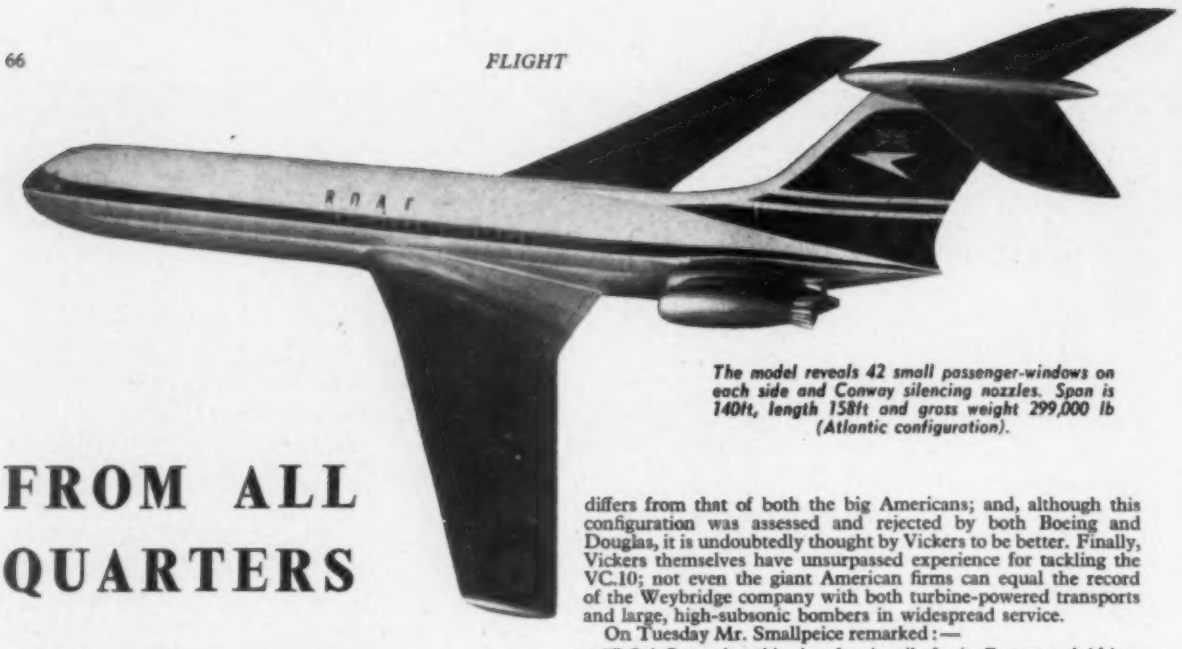
—or the World Set Free?

It is necessary to remind ourselves that the above quotations are not from any current novel. They first saw print in May 1914. And if that fact cannot be credited (it is indeed scarcely believable) they can be verified in *The World Set Free,* by H. G. Wells—verified, that is, if the book itself can be procured, for being the work of a "Utopian," and thus, in the current idiom, off-beat, it is not in wide circulation.

The same book alludes to "bombers with atomic engines," and it pictures the last great battle thus: "Athwart this whirling rush of aerial duels came a great wind and a crash louder than thunder. . . . The surviving aeroplanes turned about and fled out of the sky, like things that suddenly know themselves to be wicked . . ."

Contrast this apocalyptic vision with the idea—still rife—that war has some sort of ennobling influence on mankind—"vitalising and purifying," as Ruskin had it. The vitalising influence on the British Isles of half a dozen hydrogen bombs is certainly worth pondering; and it might be asked if their delivery will prove to be the ultimate destiny of the aeroplane, or whether human affairs may not be so ordered that sleek, podded jetliners will yet shuttle across the world bearing men of affairs, statesmen and film stars; the mighty turboprops will lift their tens of thousands of tourists and trippers at railway fares; the VTOLs and STOLs will hum around feeding, ferrying, rescuing and relieving; the business aeroplanes will whisk the salesmen from contract to contract—and even the private owner will be set free with the rest of them. . . .

It *could* happen; but whether by means of America's colossal rearmament or of the proposed summit talks is not for this journal to suggest. Wells had it in 1914 that "the people who listened in 1958 were eager before 1959 was four months old to know what might be done . . ."



The model reveals 42 small passenger-windows on each side and Conway silencing nozzles. Span is 140ft, length 158ft and gross weight 299,000 lb (Atlantic configuration).

FROM ALL QUARTERS

B.O.A.C. Signs for 35 VC.10s

ON January 14, at London Airport, B.O.A.C. managing director Mr. Basil Smallpeice and the managing director of Vickers-Armstrongs (Aircraft), Sir George Edwards, put their signatures to the biggest contract ever placed for a British civil aeroplane; in fact it is nearly the most valuable airliner order yet placed anywhere. Full details of the contract will probably not be known for many months, but it includes the sum of £60m (presumably exclusive of spares) for 35 VC.10 aircraft, plus provision for future purchase of another 20.

B.O.A.C.'s post-war history of aircraft sponsorship has not been a happy one. Notwithstanding its unique position in having almost *carte blanche* to order precisely what it wants from the British industry, the Corporation has recently had to place substantial orders with both Douglas and Boeing in order to maintain its competitive position. Early last year discussions were held with the M.T.C.A. and de Havillands with a view to the development of a project known as the D.H.118. This later evolved into something very different from the original conception and the plan finally came to a complete standstill. Then, in May, B.O.A.C. announced their intention of buying a fleet to a design known as the Vickers VC.10; this was stated to meet their need for equipment on the routes to Africa, Australasia and the Far East from the mid-1960s, and—remarkably—to be capable of development for Atlantic operation. It is now clear that Vickers have succeeded—on paper, at least—in achieving what has eluded every other transport manufacturer: production of a vehicle which, while highly competitive on medium-range routes, can offer non-stop schedules over the Atlantic.

It is understandable that Vickers are not at present prepared to say much about their mammoth project, other than that it will have four Rolls-Royce Conways and will generally resemble the model shown here (the three-view drawing is our own, prepared from the model). At this juncture we can only surmise how the VC.10 will perform, and in particular how it will show up against the Boeing 707 and DC-8. Sir George Edwards describes the design as "the first big jet aeroplane to take advantage of the attack which modern design knowledge can launch on one of the big handicaps of the pure jet—its airfield limitations." This is a statement of great consequence. Moreover, he goes on to say:—

"The VC.10 will come into service several years after the first big U.S. jets and consequently must offer distinct improvements. The VC.10 does this. Although it has a higher cruising speed, the significant advantage over its American competitors lies in its ability to carry substantial payloads over long distances on routes served by or including 'difficult' airfields. This will result in improved flexibility of operation and, therefore, better all-round economy."

It seems self-evident [writes the Technical Editor] that Boeing and Douglas, having cleared the 707 and DC-8 from their project and preliminary engineering departments, can build into future versions of these aircraft any "modern design knowledge" available to Vickers. How, then, can the VC.10 be better?

First, Vickers have started three years later (five, compared with Boeing), and so can have a newer conception on which to build. Second, Vickers can probably avoid the American firms' mistakes, simply by watching how they get on. Third, the VC.10 probably presupposes improved powerplant performance (a point referred to later). Fourth, the overall configuration of the British aircraft differs from that of both the big Americans; and, although this configuration was assessed and rejected by both Boeing and Douglas, it is undoubtedly thought by Vickers to be better. Finally, Vickers themselves have unsurpassed experience for tackling the VC.10; not even the giant American firms can equal the record of the Weybridge company with both turbine-powered transports and large, high-subsonic bombers in widespread service.

On Tuesday Mr. Smallpeice remarked:—

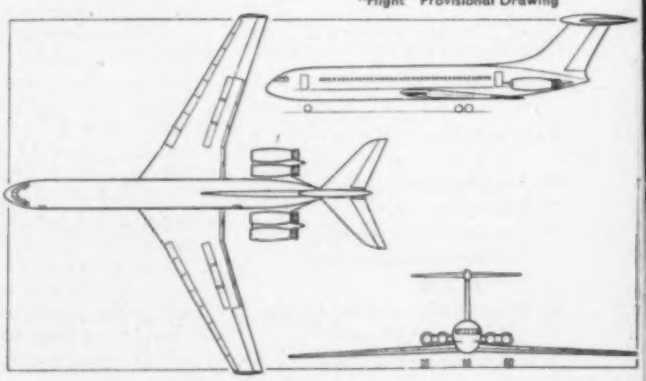
"B.O.A.C. requires this aircraft primarily for its Eastern and African routes. Because of this, great importance was attached to getting unusually good airfield performance in the design of the aircraft. The mounting of the engines at the rear will *also* [our italics] give an exceptionally quiet and comfortable cabin which I am sure our passengers will greatly appreciate. In addition, there is sufficient structural strength and power to make it as good an Atlantic aeroplane as any."

In addition, a Vickers statement speaks of the "clean wing unspoiled by engine nacelles or mountings of any kind. Such a wing can be designed to have a very advantageous lift/drag relationship, making for much improved take-off and better cruising economy." This is of particular interest, since Boeing and Douglas have actually claimed beneficial results—aerodynamic, structural and aeroelastic—from their powerplant nacelles and pylons. The American machines are handicapped by their inability to use full-depth flaps right across the span (especially is this true of the 707), whereas the VC.10 can have an optimum flap arrangement and should reach a better maximum lift coefficient than the Americans.

The VC.10 model shows conventional ailerons, three-section spoilers and what seem to be five sections of flap on each side. In addition, the leading edge seems to droop, *à la* Caravelle. Certainly the wing is uncompromised; but can it really offer a significant improvement in airfield performance? An obvious aid would be supercirculation by flap-blowing—in production by Vickers on the Scimitar—but no hint of such a system has been given, apart from a cryptic reference last May to "certain unusual features." To make flap-blowing work on the VC.10 would be an engineering achievement of the first magnitude.

Rolls-Royce's Conways could supply plenty of air for blowing, but it seems probable that their power will all be expended as thrust. The published rating (RCo.10) for the first 500-series Conway is 16,500 lb. One is led to believe by Sir George's comments [continues the Technical Editor] that Rolls are now promising still greater thrust. This would be reflected in improved take-off performance as well as longer range. On the other hand, the "developments" may concern s.f.c., in which case only range would be improved. In either case Rolls-Royce would probably be prepared to sell the improved Conway for installa-

"Flight" Provisional Drawing



***DELIVERY PARADE** for the first of 53 Avro Aircraft CF-100 Mk 5s for the Royal Belgian Air Force, at Beauvechain last month. Consultants concerned with the order were Simina Intair, Ltd.*

tion in American airframes, as they have done with the 505 *et seq*.

Will the VC.10 be lighter than its competitors? Owing to its later conception—and assuming that Vickers are able to invest in sophisticated, and extremely expensive, tooling—it should be several per cent lighter than a 707 or DC-8 for a given route. Attempts to work out relative figures for drag for the three aircraft when all are flying at, say, 200,000 lb, is a massive exercise; the result is inconclusive, the VC.10 wing profile being unknown. Shortage of moment arm—resulting from the rearward powerplant location—has made the VC.10's tail enormous. Fuselage volume must be well over 6,500 cu ft. Cross-section is clearly very similar —if not identical—to that of the Vanguard. Owing to its greater length the VC.10 can seat 108, 135 or 152 in three typical configurations—implying two more seat-rows than the turboprop aircraft.

Vickers have now been heavily committed to the VC.10 for over a year. They must know by now just what it will do; and it is worth noting that its first customer describes it as "potentially a world-beater"—as it must be. B.O.A.C. have obviously decided to sink or swim with it, and to make it the backbone of their fleets by 1965. On page 497 of our September 20 issue we published curves of B.O.A.C. traffic growth and capacity up to 1966-7, and this suggests that, with the Boeing 707-428s, the 55 VC.10s will meet all the Corporation's needs. With only 35 VC.10s there would be a deficiency of 1,150m passenger-miles annually.

A further significant point is that the VC.10 programme is being financed entirely by Vickers. In view of the protracted negotiations concerning the B.E.A. jet transport (pages 69 and 94) it is noteworthy that Vickers are being permitted to handle the much bigger VC.10 without Ministerial pressure for a co-operative effort with other companies.

Atlas No. 4

THE fourth XSM-65 Atlas was successfully fired over a range of 608 miles at Patrick A.F.B. on January 10. No sustainer was fitted. A newspaper report states that the firing was delayed by one day owing to the loss within the weapon of a metal pin ¼in in diameter and 2¼in long; eventually Mr. Osbert Goldinger, an employee of either Rocketdyne or Convair, was lowered into the weapon wearing an oxygen mask and retrieved the pin in a few minutes.

Fairey's Happy Family

"MEMBERS of the family" is how the distinguished guests were described at a dinner for long-service employees of the Fairey Aviation Co., Ltd., held in London last Saturday. And certainly their ties with Fairey were close indeed. There was Admiral Sir Denis W. Boyd, now Principal of Ashridge College, but at one stage during the war the Captain of H.M.S. *Illustrious;* he commanded that carrier at the Battle of Taranto when her attacking forces of Fairey Swordfish destroyed, or disabled, half the Italian Fleet. From 1912 until his retirement in 1949, Admiral Boyd was almost continuously associated with Naval aviation and with Fairey aeroplanes. Then there was Air Marshal Sir Bryan V. Reynolds (now A.O.C-in-C. Coastal Command) who, as a wing commander, was based at the Fairey factories at Stockport and Hayes at the beginning of the war as an M.A.P. overseer. The third guest was Mr. G. W. H. Gardner, Director of R.A.E. Farnborough, who was visiting Faireys for technical discussions of requirements more than 25 years ago.

Arranged by the Fairey Long-Service Association, the dinner was attended by 408 employees who had been with the company for 25 years or more. Two hundred and forty-six of them received gold watches and testimonials from the company, the remainder having received similar presentations from the late Sir Richard Fairey when the first dinner was held in 1949.

***LONG-SERVICE RECOGNITION:** Mr. G. W. Hall, Fairey chairman and managing director, makes a presentation to Mr. Charles Mills—who joined the company in 1925—as representative of 245 other long-service employees (see news-item, "Fairey's Happy Family," above).*

I.A.S. Honours

AT the Institute of the Aeronautical Sciences' honors night dinner on January 28 the president of the Royal Aeronautical Society, Sir George Edwards, is to present the society's gold medal to the Institute's first president, Mr. Jerome C. Hunsaker. Mr. Hunsaker is Professor Emeritus, Massachusetts Institute of Technology, and was N.A.C.A. chairman from 1941 to 1956. He is to receive the award "for his contributions to aeronautical research and education, including his inspired chairmanship of the N.A.C.A."

Among others to be honoured at the dinner are Mr. Arthur E. Raymond, vice-president engineering of Douglas Aircraft and 1946 president of the I.A.S., who will receive the Daniel Guggenheim Medal; and Mr. William Littlewood (vice-president, equipment research, American Airlines) and Herr B. K. O. Lundberg (director of the Aeronautical Research Institute of Sweden), who are to be given honorary fellowships. Maj. David G. Simons, the U.S.A.F. doctor who last August made a balloon ascent to over 100,000ft, is to be presented with the John J. Jeffries Award; and a new award for outstanding work in helicopter development is to be conferred on a person who will be identified at the dinner.

Blackburn A.P.U.s for C L.44

THE Engine Division of Blackburn and General Aircraft, Ltd., are to supply the auxiliary power units for the Canadair CL.44 transport. Announcing this, the makers remark that the order follows the supply of Palouste units for ground-starter trolleys for the Orenda Iroquois turbojet, to be used in the Avro Arrow. They add: "This latest dollar order is for Artouste 510 gas turbines which provide shaft horse power in addition to compressed air bleed, the former driving an alternator and the latter being employed for pneumatic starting of the main engines and for air conditioning." The whole unit can be installed as a self-contained power pod 74in long and of 24in diameter.

NATO Dinner at Cranfield

THE value of co-operation between the NATO countries in the field of guided-weapon development was stressed by Dr. R. Cockburn, Controller of Guided Weapons and Electronics, Ministry of Supply, in a speech at the College of Aeronautics, Cranfield, on Friday last, January 10. The occasion was a dinner at which industry and Government representatives were able to meet the members of the second NATO guided missiles course at the College.

Replying to the toast of the guests, Dr. Cockburn said he felt technocracy was getting out of hand—science should contribute to the philosophy of living, not only produce material benefits, and the scientist should spend more time explaining his philosophy to the rest of the community. Some of us were worried at the high proportion of national expenditure which went on defence, but there was an inevitable duty to conserve and protect our way of life, and scientific effort in the field of defence did have a direct effect on the country's civil standards.

The conception, development and production of guided weapons, Dr. Cockburn said, demanded a long time and an

FROM ALL QUARTERS . . .

immense investment. Development on separate lines by each of the major allies was "crazy," but the answers to the problems of co-operation were not simple. Clearly the sharing of knowledge must be carried out on some basis of reciprocity.

The Principal of the College of Aeronautics, Prof. A. J. Murphy, proposing the health of the guests, disclosed that this year's NATO course comprised 24 students from seven countries—Belgium, France, Italy, the Netherlands, Norway, Portugal and Turkey. One of the students of the first course, Maj. F. Romano of Italy, had returned to take further specializations in the second course. The speaker was certain that the exchange of technical knowledge between NATO countries was facilitated by the Cranfield course; for the future, the field of recruitment should be widened.

The remaining speakers at the dinner were Lt. O. Linge, Norwegian Army (one of the NATO students), and Sir Frederick Handley Page. In an extremely amusing and well-delivered speech, Lt. Linge traced the reactions of the students from the first days when they had received lecture supplements so secret they were marked "Destroy before reading." At the present time a notable stage had been reached: while he would not claim that all aspects of missile engineering were clear to the members of the course, at least they were confused on a very high level.

U.S. Missiles Chief Resigns

THE U.S. Army missiles chief, Lt-Gen. James M. Gavin, has resigned. He stated that this was because budget cuts were denying "the necessary weapons" to the Army. Gen. Gavin commanded the 82nd Airborne Division when only 37. Mr. Wilbur Brucker, U.S. Army Secretary, said that he had accepted the general's resignation only after final attempts to make him change his mind had failed.

English Electric Appointments

SEVERAL new appointments in the English Electric aviation group are announced. In the aircraft division at Warton, Mr. R. F. Creasey takes the new post of deputy chief engineer, responsible to Mr. F. W. Page, chief engineer; Mr. B. O. Heath becomes chief project engineer, under Mr. Creasey; Mr. E. Loveless is appointed chief airworthiness engineer, with responsibility to Mr. Page; and Mr. F. E. Roe becomes chief development engineer, responsible to Mr. Creasey. These last three are also new posts.

Mr. J. C. King, who was an assistant chief engineer and was with the aircraft division for 12 years, has now joined the English Electric Company's directorate of engineering in London. In the aircraft equipment division at Bradford, Mr. W. G. Friggens has been appointed assistant manager, responsible to the Divisional Manager, Mr. P. J. Daglish, and Mr. T. E. Simms becomes chief sales engineer. Finally, Mr. W. Fisher has joined the guided weapons division in London as head of overseas sales, under Mr. E. L. Beverley, commercial manager of the division.

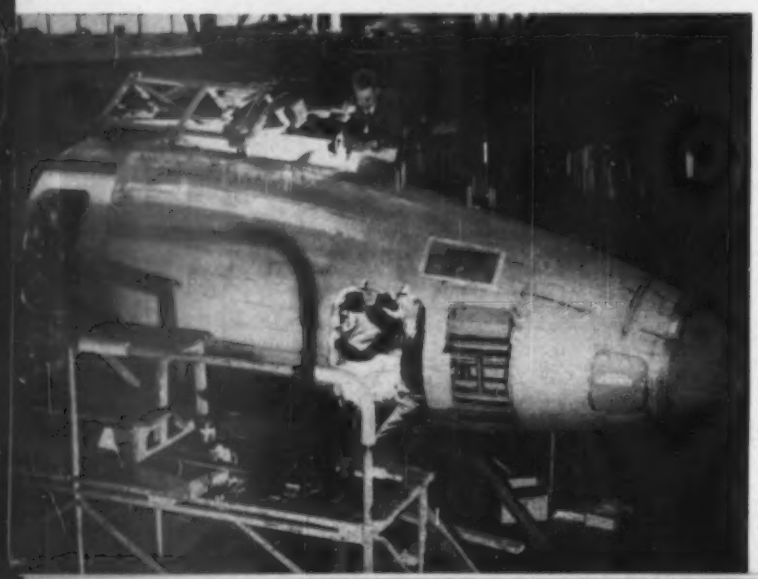
Highlights from the careers of some of the above-named are as follows:—

R. F. Creasey: Came to English Electric from Vickers-Armstrongs in 1946; as chief aerodynamicist in 1950 was responsible for P.1 aerodynamic design. Appointed chief project engineer in 1954.

B. O. Heath: Joined English Electric stress office in 1945, working on the Canberra, and was subsequently an aerodynamicist of the P.1 team. Became aerostructural engineer in 1951.

E. Loveless: Became a member of aircraft Division in 1946 and chief stressman in 1950. Had formerly been with Blackburns (from 1936) and Scottish Aviation (1946).

F. E. Roe: As one of the company's first graduate apprentices, joined aircraft division in 1946. In 1950 was put in charge of all wind-tunnel work, and later initiated work on the Mach 4 tunnel now being built at Warton.



NEW POSTS: Mr. W. G. Friggens (left) and Mr. T. E. Simms, two of the executives of the English Electric aircraft equipment division whose reappointments are announced in a news-item on this page.

W. G. Friggens: Following an English Electric apprenticeship in 1946 and a period with Standard Telephones, returned to the former company in 1949 and was thereafter concerned mainly with the electrical engineering side. In 1953-55 was in charge of the development section, and was then made personal assistant to manager of aircraft equipment division.

T. E. Simms. Joined aircraft equipment division as projects and applications engineer in 1952 after posts with Rolls-Royce, Kontak Mfg. Co., and service in the Royal Navy.

W. Fisher: An Australian who joined the R.A.F. in 1938, attaining the rank of wing commander and commanding the Arab Legion Air Force under Gen. Glubb Pasha, Mr. Fisher subsequently went to Handley Page as military liaison officer. Joined English Electric guided weapons division last year.

Decca Directorships

THREE new appointments to the Board of the Decca Navigator Co., Ltd., are announced. They are those of Mr. Herbert C. Lambert, Mr. George Hawker, B.Sc., and Mr. Graham L. Coles.

Mr. Lambert has been chief accountant of the Decca group of companies since 1947; and now, in addition to becoming a director, he is appointed group controller. Mr. Hawker joined the company in 1946 after R.A.F. experience in navigational-aid planning. He was appointed head of the systems planning division in 1950 and commercial manager in 1951. Mr. Coles joined the marine sales staff in 1946 after distinguished service in the Royal Navy and became manager of the marine division in the following year.

MR. L. A. SANSON, who has been appointed Napier's senior resident representative in Canada in succession to Mr. P. J. Waite. He will be responsible for the company's aviation and diesel activities, and will also represent the guided weapon and aviation equipment divisions of English Electric. His office will be at 6035 Cote de Liesse Road, Montreal 9, P.Q. Mr. Sanson was formerly European representative for Napier turbo-blowers and Deltic turbo-charged diesel engines.

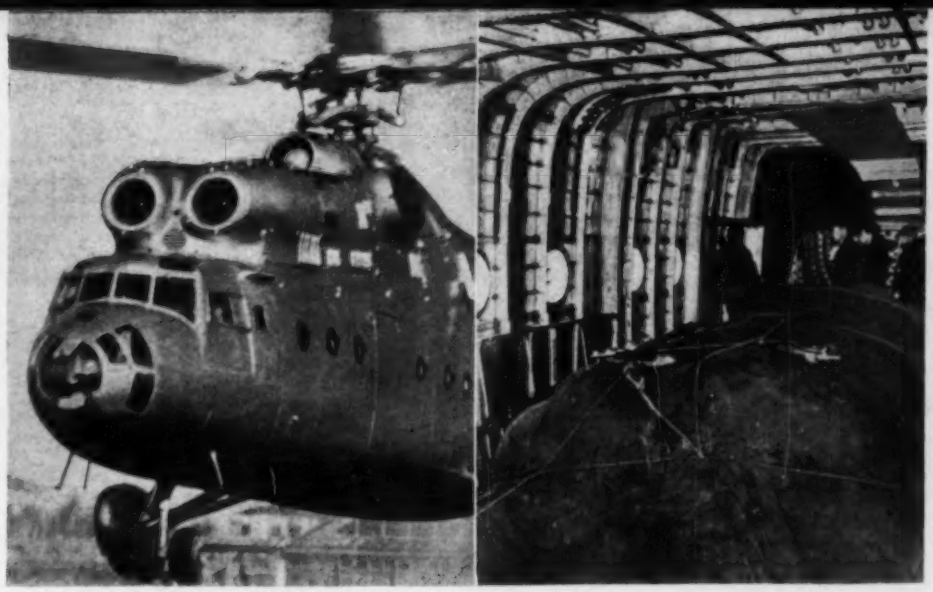
Derby Aviation Group Reorganization

IN the New Year a new company within the Derby Aviation Group came into being. Known as Derby Aerosurveys, Ltd., it will combine the air survey activities formerly carried out by the parent company from Derby Airport and the oblique photography formerly carried out by Photoflight, Ltd. an independent company that has operated from Elstree for the last ten years.

The chairman is G/C. C. A. B. Wilcock, O.B.E., A.F.C., A.F.R.Ae.S., M.P. (who is chairman of all the companies within the group) while the managing director is Mr. E. W. Phillips, M.B.E., who has been a director of Derby Aviation, Ltd., and Air Schools, Ltd., for many years. Lt-Col. H. C. Butcher, D.S.O., formerly managing director of Photoflight, joins the new company as Technical Director, and Mr. D. F. Ogilvy becomes operations director.

The registered offices are at 78, Buckingham Gate, London, S.W.1 (Abbey 2345) but most of the administrative work and the oblique photography (with the aid of two specially equipped

BELFAST PRODUCTION of the Canberra P.R.9 is well advanced at Short's Queens Island factory, and a nose section is seen in this new picture. Considerable design work has also been undertaken. Shorts have already built more than a hundred Canberras of various marks.



***CHAMPION WEIGHT-LIFTER** helicopter is Russia's Mi-6, powered by two gas turbines of some 4,000 h.p. each. These new pictures show the nose and the interior, with the record-breaking load of 26,460 lb which was lifted to 7,870ft.*

Austers) will be carried out from Elstree Aerodrome (Elstree 3148 or 3070). Aircraft flying on survey work will be stationed near the scene of operations, but will return to their home base at Derby for maintenance. Two Ansons will normally be used for such duties, but when larger types are needed Derby Aviation's Marathons and Dakotas will be available.

Bedford Tunnel Discussed

A COMPREHENSIVE discussion on some of the most intriguing aspects of the 8ft × 8ft supersonic wind tunnel at the Royal Aircraft Establishment, Bedford, was held at the Institution of Electrical Engineers on Thursday, January 9. Four main papers, concerned with the main drive to the tunnel, its speed control, and control of the flexible walls, were presented. The papers were: *The Development of Variable-speed High-power Drives for Large Wind Tunnels*, by P. McKearney, L. S. Drake and E. G. Mallalieu; *A Variable-frequency Power Installation for Large Wind-tunnel Drives* by the same three authors; *Speed Control of Large Wind Tunnels, with Particular Reference to the R.A.E. 8ft × 8ft High-speed Tunnel*, by L. S. Drake, J. A. Fox and G. H. A. Gunnell; and *Automatic Setting of the Flexible Walls of a Large Wind Tunnel*, by T. Barnes and C. R. Dunham.

Authors McKearney (who presented the papers in summarized form at the meeting), Drake, Mallalieu and Barnes are at the Ministry of Works; Messrs. Fox and Gunnell are with the English Electric Co., Ltd.; and Mr. Dunham is at the research laboratories of the General Electric Co., Ltd., at Wembley.

SIR THOMAS SOPWITH ON THE B.E.A. JET ORDER

IN his address to Hawker Siddeley shareholders, at the group's annual general meeting in London on January 8, Sir Thomas Sopwith (chairman) referred to the B.E.A. jet airliner controversy and to the company formed jointly with the Bristol Aeroplane Co. to carry through the Bristol 200 project. After describing events leading up to the formation of the new company Sir Thomas said:

"To our way of thinking this merger made sound sense and was exactly in line with Government policy—and no one seems to debate or argue this point. Everyone seems agreed that this combination of the most recent civil airliner experience enjoyed by Bristol with their great Britannia and Hawker Siddeley with its outstanding record of high-speed flight in exactly the very difficult Mach 0.9 speed regime, is an unbeatable combination. . . .

"To our astonishment, however, we now find that suggestions have been raised as to the technical superiority of one of the paper designs submitted to B.E.A. . . . I am prepared to say to you today, flatly, that in this case talk of the technical superiority of one aircraft on paper over another is nonsense. The basic designs submitted to the B.E.A. specification are almost exactly alike. In fact, if you were to see the configurations, I doubt whether you could tell the difference. They each have three jet engines mounted on the rear fuselage, and the engines are exactly the same. They each have the same swept wing configurations. It is my belief that talk of technical superiority at this stage is simply a smoke-screen which should be dispelled without further ado—a rather bad case of technical smog.

"At present, comparison is being made on a basis of design studies only. It is well known to those acquainted with aeronautical engineering that, whilst it is possible to raise a wide variety of technical arguments at this stage the technical merit of the final product is determined by far more than the original design sketches. . . The eventual quality of the product is determined by the quality and strength of resources in terms of knowledge, experience and facilities which are placed behind the project. . . Hawker Siddeley is one of the few companies which has had experience of designing, deve'oping and putting into successful operation big jet aircraft flying in the speed range demanded by the new B.E.A. airliner. . . No one can doubt that the combination of the technical resources of Hawker Siddeley and Bristol would be more than adequate for a venture of this kind. . . .

"Let there be an end, therefore, to this ill-founded gossip that the product we are offering is technically inferior to that of our competitors, and that we at Hawker Siddeley and Bristol are engaged in some sort of a plot with the connivance of Ministers of the Crown to force an inferior product on a reluctant customer. This we will not tolerate."

Earlier in his address Sir Thomas had reviewed the general progress of the group during the year. The acquisition of the Brush Group and Dosco (Dominion Steel and Coal Co., Ltd.) had changed the character and structure of Hawker Siddeley. Two years ago the net assets of the group had been divided in the ratio of 85 per cent aviation and 15 per cent industrial. Today, they were roughly 30 per cent aviation and 70 per cent industrial.

Considerable success in the export field had been achieved by the group during the year, and this would help to keep its factories occupied for some little time to come. Orders included a £30m contract from the Indian Government for Hawker Hunters and Hunter two-seat trainers; an order for 68 Sea Hawks from Germany, numbers of Orenda engines for their F-86s [Sabre 6s]; and Avro Aircraft CF-100s for the Royal Belgian Air Force.

Work was well under way with the Armstrong Whitworth Freightercoach, and contributions from other companies in the group were helping to produce this aircraft quickly. Sales prospects were promising. The Orenda Iroquois would be powering the Avro Arrow, and an agreement for the manufacture of this engine in the United States had been signed by the Curtiss-Wright Corporation.

Progress was being made in the guided weapons field. The performance of Armstrong Whitworth's Sea Slug was encouraging, and it could now be disclosed that Avro's activities in the weapons field included the stand-off bomb, which was the logical armament for the V-bombers.

The Hawker Siddeley Nuclear Power Co., Ltd., was now well established and had been examining a number of reactor system projects for land and marine use. It was well placed for undertaking specialized reactor project studies.

Research and development facilities throughout the group were continually being improved, and research work had been carried out for major aircraft and missile companies outside the group. It was vital that research should continue. "Most of our understanding and experience of flight comes from its application to defence," continued Sir Thomas. "Civil aviation has benefited considerably by the urgency and the resources with which the military problem has been pursued. We are now suddenly faced with the prospect of being deprived of this advantage." If the country proceeded with its research programme the time might come when we would want to apply the knowledge acquired. and it was therefore essential that the fund of knowledge should be continually added to.

In his summary of the group's financial results for the year ended July 31, 1957, Sir Thomas said that the profits before taxation amounted to £12,108,483, compared with £12.847.867 in the previous year—a decrease of £739,384. These profits were, however, shown after charging £6.341,649 depreciation on fixed assets, compared with £3,935,856, the heavier charge being mainly due to depreciation of Crown-owned machinery acquired in Canada at the end of last year. In addition to those profits there were adjustments arising this year in respect of deliveries of prior years amounting to £2.039,392 after taxation. £5,365,294 of the net profits after tax had this year been retained in subsidiaries.

THINKING ABOUT ENGINES

Possibilities and Problems: A Lecture by Mr. A. A. Lombard

FUTURE lines of development of the aircraft gas turbine, and the obstacles that may be encountered, were discussed by Mr. A. A. Lombard, F.R.Ae.S. (chief engineer, aero division, Rolls-Royce, Ltd.), in a lecture, *Thinking about Aircraft Engines*, to the Leicester Branch of the R.Ae.S. on January 15 at Loughborough College. A summary of his principal points is given below.

After outlining some of the avenues of development, the lecturer showed that the jet engine, particularly for military application, was at its best at speeds of over M = 2.5, and for performance was still attractive at M = 3. Although this development in performance was possible, practical problems placed its realization a few years away. (Advanced turbojets and ramjets are compared in Fig. 1.)

The situation for military aircraft could be summarized as follows: —

1. A quite considerable gap exists between today's achieved performance and that limited by the optimum reheat jet engine.
2. The high thermal efficiency of the jet engine at M = 3, 60,000ft, may be sufficiently attractive to demand the development of a low-pressure-ratio jet, particularly if long range is a requirement.
3. If there is a demand for a sustained flight performance beyond M = 3 or 60,000ft, then the ramjet becomes attractive, either with a separate booster or combined with a ducted jet or a turbo-rocket.

Regarding engines for commercial transport aircraft, the lecturer pointed out that there was a significant fall in specific fuel consumption for turboprops, even up to very high pressure ratios, but beyond a certain value this was offset by an increase in specific weight. At one hour's flight duration the two parameters were of equal importance, but with greater duration specific fuel consumption became increasingly significant. A graph (Fig. 2) showed the values of the parameter $\frac{\text{engine weight + fuel weight}}{\text{aircraft gross weight}}$ for various values of flight endurance. The by-pass jet was superior at all ranges at flight speeds above 450 m.p.h.

For high-subsonic long-range operation a high-pressure-ratio by-pass engine operating at high temperature for take-off was essential. It was worth emphasizing the need to develop high take-off thrusts even under conditions of high ambient temperature and high aerodromes, since this might influence operating economics in an overriding manner; the extra degree of freedom of a by-pass engine was capable of being exploited to this end, and the ability to operate at high combustion temperatures was essential.

For short- to medium-range jet-transport operation, an engine employing a high pressure and by-pass ratio was required. The fuel reserves on this type operation might be as large as the amount consumed during flight; and the ability to land, exchange passengers and take-off, without refuelling, was another requirement. The possibilities of the jet flap and other lift devices would be particularly applicable to short-range operation.

Due to tip vortices, there was a maximum value of induced lift for wings of finite aspect ratio. However, by using the jet flap it was possible to obtain lift coefficients as high as 12, compared to the normal value of about 2.5. A further advantage of the jet-flap wing was its relative insensibility to angle of attack near the stall, thus allowing latitude in choice of landing and take-off attitude. There was a problem in distributing the jet exhaust along the wing trailing edge. For the high-lift case the jet sheet could be deflected by a small trailing-edge flap, but there must not be a loss of thrust during cruise flight. Tests at the N.G.T.E. indicated that this loss could be made negligible by suitable slot design and choice of exit velocity.

Lift could be increased by control of the boundary layer, which could be achieved by suction applied either near the leading edge or near the flap hinge line. Blowing over the flap surface (the Attinello flap) was the most practical method but was less economical in air requirements. Up to 100 per cent increase in lift coefficient was possible with considerable reduction in take-off and landing distances.

Profile drag could be reduced by delaying, reducing or avoiding the transition of laminar to turbulent flow. Drag reductions of about 40 per cent of the total aircraft profile drag should be possible if laminar flow could be maintained on wing and tail surfaces.

Looking at the overall thermal efficiency of the jet engine (without reheat), continued Mr. Lombard, it was seen that this increased to a figure of 38 per cent at a flight Mach number of 2.5. If a favourable lift/drag ratio could be achieved, long-range flights at this speed would become an economical possibility. One possible solution was to optimize the aircraft and engines for this condition, ignoring all take-off and landing requirements. Only a low lift-coefficient would be required and, as proposed by Griffith, a highly swept delta fuselage with its leading edge well behind the Mach angle, and with high wing-loading, low skin-friction and the minimum of parasite drag, might be the answer. At its design lift coefficient it would need lift augmentation for take-off, and direct jet lift was proposed.

On the subject of the nuclear-powered aeroplane the lecturer made the uncompromising assertion that "as a practical military aircraft fulfilling a need incapable of fulfilment in a better manner by other means, it is some distance away. As a commercial transport, and at the present state of knowledge, it can be ruled out."

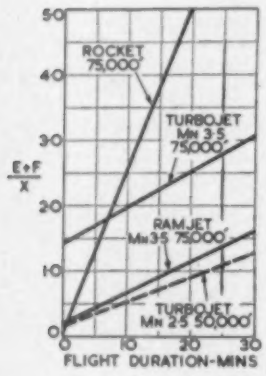
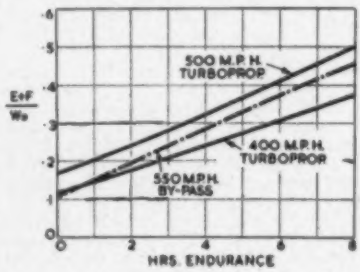


Fig. 1 (left). Weights of engine and propellants for different durations.

Fig. 2. Propulsive-system weight in relation to aircraft all-up weight.



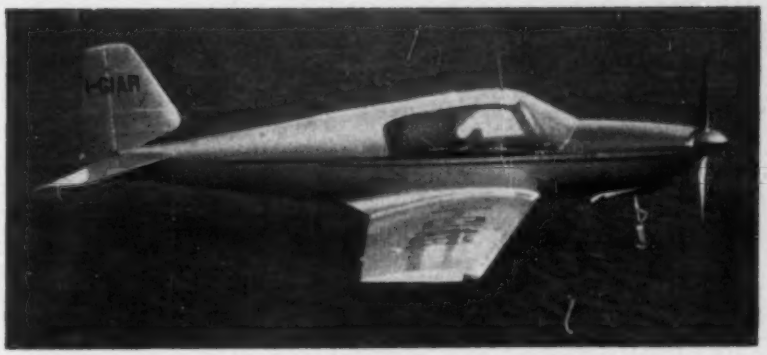
UPPER-ATMOSPHERE PHENOMENA

IN a lecture given to the British Interplanetary Society at Caxton Hall, on January 4, Dr. R. F. L. Boyd, of University College, London, discussed the research being undertaken during the International Geophysical Year into the phenomena which can be observed at the high levels of the Earth's atmosphere.

After reviewing some of the surface methods which can be used to determine the properties of the atmosphere, Dr. Boyd described the difficulties which attended observations of the solar spectrum. At the ground, he said, the atmosphere had only a narrow "window" through which visible light and the near ultra-violet and infra-red could pass, but at altitudes of 100 km or more the window widened to permit all radiations from gamma rays to short radio waves to enter. When viewed in these circumstances, the Sun did not behave as a black body at the temperature of the chromosphere, 6,000 deg K; while with infra-red light only about one-sixth of the black-body radiation was produced; at wavelengths corresponding to the ultra-violet and X-rays the radiation was hundreds or thousands of times more intense, corresponding to a temperature of about three-quarters of a million degrees centigrade. This radiation, which came from the highly excited outer atmosphere of the Sun, had been observed only since the introduction of rocket soundings.

Dr. Boyd said that, although the atmosphere at great heights allowed wide bands of radiation to be seen, there were instrumental difficulties which had not yet been overcome: ionization counters, which offered a most convenient method of measuring the radiations, had to have windows to permit the radiation to ionize the detecting gas, and at the moment all the available windows excluded the wide band, in the ultra-violet, between 50 and 1,000 Angstrom units. Windowless counters, which leaked gas continuously, were being developed. The lecturer also cited other investigations with rockets and satellites.

Dr. Boyd is closely associated with the Woomera firings of the R.A.E. Skylark rocket, which, he said, was giving excellent service. Recent tests had shown that the dispersion of the trajectory was very low, so that firings from Aberporth could be undertaken safely, thus probing a different section of the atmosphere. An excellent set of data from a grenade experiment (to measure the temperatures and winds in the upper atmosphere) had been obtained, and was being analysed electronically.



GRAN TURISMO: First picture of the Aviamilano Nibbio four-seater, described in "Flight" for December 20. The first flight is imminent, the first production machine is already bespoken; and the company is eager for licence agreements in other countries.

HERE AND THERE

German Interest in the P.1

IN Bonn on January 7 A. Cdre. Strang Graham, liaison officer for the English Electric Co., Ltd., said that the P.1 was one of the aircraft "under consideration" by the West German Defence Ministry and that they might ask for a further demonstration to be given. A Defence Ministry spokesman said on January 12 that a decision on the type of aircraft to be bought would probably be made this month.

Trenchard Lecture

AT the Halton branch of the Royal Aeronautical Society on February 20 the Chief of the Air Staff, Marshal of the R.A.F. Sir Dermot Boyle, is to give the first Trenchard Memorial Lecture.

Fiat-U.S.A.F. Agreement

UNDER a newly concluded agreement with the U.S.A.F. the Fiat works at Turin is to undertake the reconditioning of 60 F-86 Sabres. Machine tools required are to be supplied by the U.S. Government.

West German Helicopter

THE prototype Borgward-Focke Kolibri, first helicopter to be designed in Germany since the war, was completed at the Borgward works on January 6. Flight tests of the aircraft, which is fitted with a 260 h.p. American engine, are due to begin this month.

Cranfield Professorship

MR. JOHN LOXHAM, C.G.I.A., M.I.Mech.E., M.I.Prod.E., has been appointed Professor of Aircraft Economics and Production at the College of Aeronautics, Cranfield. Prior to joining the Sigma Instrument Co., Ltd. (of which he is managing director) in 1939 Mr. Loxham was Head of the Engineering Production Department of Northampton Polytechnic, London, where he established the first National Certificate course in Production Engineering. In 1946 he was awarded the Sir Joseph Whitworth Prize by the Institution of Mechanical Engineers, and the City and Guilds of London Institute recently conferred on him the Insignia Award in Mechanical Engineering for 1957 in recognition of his work in the field of precision engineering. He takes up duties at Cranfield on April 1.

C.A.I. Appointment

IT is announced that W/C. H. L. Taylor has been appointed assistant secretary of the Canadian Aeronautical Institute. He recently retired from the R.C.A.F. after 29 years' service, his appointments having included those of chief engineering officer, senior aeronautical engineering officer and director of maintenance services. His last Service post was as equipment general control officer at Air Materiel Command Headquarters. In his new appointment he will assist Mr. Charles Luttman, C.A.I. secretary.

W/C. H. L. Taylor

R.Ae.S. Lecture Cancelled

AN R.Ae.S. section lecture on *Power Controls for Supersonic Aircraft*, which was to have been given by G. Selwood, A.F.R.Ae.S., on February 4 has been cancelled.

Busy O.s and B.s

FOLLOWING the achievement of the R.A.F. Otter in becoming the first single-engined aircraft to fly across the South Pole (a photograph of it appears on page 92), de Havilland Aircraft of Canada, Ltd., have pointed out with justifiable pride that there are nine other Otters—with the U.S. Navy expedition—and six Beavers operating in the Antarctic. The Australian expedition is using three of the latter aircraft and the N.Z., Chilean and Japanese contingents one each. (As we go to press, a reader—whose letter will appear next week—challenges the "first single-engined" claim, citing Lincoln Ellsworth's 1935 flight.)

CELEBRATING his 70th birthday on January 24 is Prof. Dr. Ernst Heinkel, among whose accomplishments was the design of the first successful jet-propelled aeroplane—the He 176.

Whitehall to Fleet Street

FOLLOWING his retirement from the R.A.F. last September, Air Chief Marshal Sir Ronald Ivelaw-Chapman (who was V.C.A.S. from October 1953 onward) has been appointed a trustee of *The Observer* newspaper.

Monte Carlo News

THREE successive issues of *The Autocar* will supply motoring enthusiasts with that journal's biggest-yet coverage of the Monte Carlo Rally—today, January 17, preview; January 24, report; and January 31, review.

Seaborne Proteus

THREE Bristol Marine Proteus engines—basically similar to the Britannia power units but operating at a lower rating—propel H.M.S. *Brave Borderer*, the first of a new class of fast patrol boat for the Royal Navy. She was launched from the Portchester yard of Vosper, Ltd., on January 7.

R.S.A. Prizes

PRIZES offered by the Royal Society of Arts for 1958 include the Howard Prize of £50 for mechanical motive power and the Fothergill Prize of £20 for fire prevention or fighting. In 1957 the Howard prize was won by Mr. A. E. Johnson, D.Sc., M.Sc.(Tech.), M.I.Mech.E., for his treatise entitled *Turbine Disks for Jet Propulsion Units*.

Avro Relic

BY a strange coincidence, shortly after the death of Sir Alliott Verdon-Roe (which we recorded last week), part of a wing which possibly belonged to an early Avro aircraft was discovered in the attic of Brownsfield Mill at Manchester, where he founded A. V. Roe and Co., Ltd., in 1910. The company say that the wing portion (which is 8ft long and 3ft wide) is constructed on lines "typical of 1914 or before."

Albanian Detentions

DURING their temporary detention of the crew of a DC-4 belonging to Independent Air Travel, Ltd. (as reported in *Flight* last week), the Albanians forced down and held the pilot of a U.S.A.F. T-33, Maj. Howard Curran. He had taken off from Chateauroux in France on December 23 to fly to Naples. It was on January 7 that a Radio Tirana broadcast reported his presence in Albania. Maj. Curran was last week allowed to leave the country.

First Things First

ON NOT SEEING THE SALES TREES FOR THE REORGANIZATION WOOD

By a Special Correspondent

SO many possible permutations and combinations of the 30 major British aircraft and aero-engine firms have been suggested in the past few weeks that there is a chance that some of our critics may lose sight of our industry's main job in 1958, which is to sell its products overseas. If it fails to do so, then no amount of consortiums or combines will bring prosperity.

And as well as the new projects now in the design offices there are still the existing products to be sold, for we must recoup as much as we possibly can from our successful aircraft and guided weapons. Whether or not Hawkers join Bristols (for instance) to form a new company, the sales campaign for orders for Hunters from those countries which are still building up their jet air forces must continue. There are several British aircraft which have survived a welter of real—and imaginary—troubles, have been proven by the R.A.F. or the Fleet Air Arm, and are now available for export. How stupid it would be if we were to concentrate our energies on rationalizing ourselves, forming larger and more efficient design teams, yet being so preoccupied that we lost the chance of selling many millions of pounds worth of our current models!

Aircraft we can almost certainly expect to continue selling in 1958 include the Hunter and the Canberra, and Westland and Bristol helicopters. These are first-class examples of products whose excellence has been proved by the Services. Customers who examine them may well look to others which have already been sold abroad—the Gannet and the Sea Hawk, in particular; the Shackleton, which has so far found only one overseas buyer; and the Javelin, which has not so far found any.

We are certain to meet strong opposition from the United States and Canada, who have themselves sold successfully to the sort of customers we are chasing. Sometimes, from the strictly commercial viewpoint, the competition is unfair—there is, for example, the apparent ability of the American and Canadian governments to use their own funds to pay for aircraft for foreign countries. Our only answer to this sort of thing is to offer something so superior that such countries will actually be willing to pay for them. One reason for the Javelin's failure to sell abroad was undoubtedly the joint U.S. and Canadian "sale" of 100 CF-100 all-weather fighters to Belgium (though that particular blow may have been softened by the fact that the Hawker-Siddeley Group as a whole undoubtedly benefited).

There is, too, a new range of military aircraft now in service, or ordered, which appear likely to interest overseas customers. There are the Sea Vixen and the Scimitar and, later in the year, there will be the P.1 and the Blackburn N.A.39. Probably the most important at the moment is the P.1, because it is this aircraft which may yet break the American stranglehold on the NATO fighter market. For this reason English Electric are now quite clearly engaged in a strong campaign to sell the P.1 to Germany, although the company is not emulating the publicity which accompanied the unsuccessful attempt by Saunders-Roe to sell the SR.177 to the same customer. The rejection of the SR.177 has probably made English Electric cautious, but their sales effort is the right answer to the American attempts to sell one of four aircraft—Grumman 98J (F11F-1F) Super Tiger, Chance Vought F8U Crusader, F-104 Starfighter and F-105 Thunderchief. Nor have the Germans rejected *all* British fighters—only the SR.177. Perhaps, too, the way in which the Ministry of Supply practically became salesmen for the SR.177 may reflect upon the sales of the P.1. If all that one reads and hears is true, they practically said "The SR.177 is the best fighter Britain can offer you." This would be no way for a Government department to behave towards an aircraft which it had not itself bought. Selling to another government is bound up in politics, and our own Government is often tremendously helpful to firms; but is it its job to recommend one aircraft and not, apparently, another? Is this the best way to sell British goods?

What of the civil side? The position here is clearer, for the Viscount has been in the spotlight of success for several years. Although the pace of placing orders has slackened compared with the time when mammoth contracts from American, Canadian and other airlines were being received, we may well expect Vickers' order-book to be as healthy in 12 months' time as it is today. To these chances must be added the possibility of a number of orders for the Vanguard. It will fly this year, and already there are two orders for 20 each from B.E.A. and Trans-Canada Airlines. The VC-10, discussed elsewhere in this issue, will be offered to the world's airlines this year, and will undoubtedly be closely looked at because it is the first British airliner to use the large Rolls-Royce Conway by-pass engines.

Less public recognition has been accorded to the gradually mounting Britannia orders. A proportion of these are for Transport Command, but the Britannia's performance with the first civil operators is bound to influence sales to newcomers. Sales of smaller civil aircraft continued last year and hold promise for the New Year, but the accident last month to the Twin Pioneer was a solemn reminder that even aircraft already selling to the world are still the concern of the engineers.

This year must, then, be a year of selling. We are notoriously bad at advertising our wares; the members of the recent Canadian Trade Mission praised British industry generally, but added that we were bad at "banging the drum." Publicity should go hand-in-hand with the salesman. We must see the end of doubtful "security" restrictions on our goods—restrictions imposed, one sometimes suspects, because decisions to spend public money are made by politicians, helped in varying degrees by their technical advisers. It is essential that back-benchers in the West German or Australian parliaments should know far more about the goods they are asked to buy. We have all had the experience of technical considerations being overruled for policy reasons. If that is done in foreign governments it may mean lost orders for Britain. We must make the politicians aware of the technical qualities of our aircraft and weapons.

Talks on the future of the British industry may last for many months yet, and some of the ill-informed discussion will inevitably be harmful by creating unnecessary uncertainty in the minds of customers and employees. Our natural love for what Pepys called "a good discourse on the general ill-state of things" is a curse upon the industry, for all is not ill, and the salesman's job will be made less difficult if such discourses are held in private. The way to achieve that is for the industry to sort itself out quickly, quietly and, above all, efficiently.

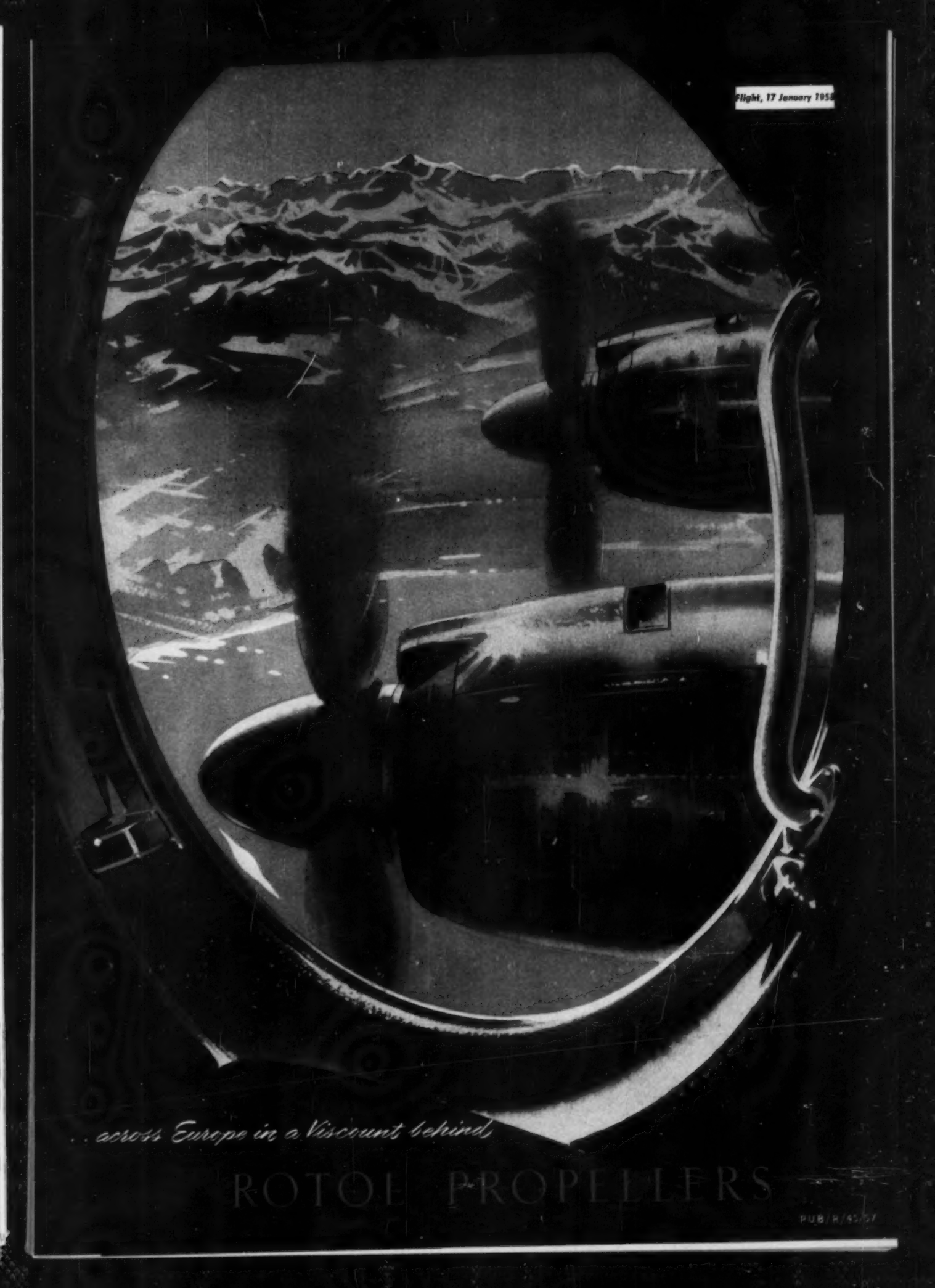
FORTHCOMING EVENTS

Jan. 17. Institute of Navigation: "Influence of Atmospheric Conditions on Radar Performance," by Dr. J. R. Saxton.
Jan. 18. Aircraft Recognition Society: All-England Contest.
Jan. 21. R.Ae.S.: Section Lecture: "Environments and Environmental Testing," by P. J. Duncton, A.F.R.Ae.S., and T. F. R. George, A.F.R.Ae.S.
Jan. 22. Kronfeld Club: Film Show.
Jan. 23. R.Ae.S.: Guided Flight Section: "Guidance and Control," by L. H. Bedford.
Feb. 1. British Interplanetary Society: "Meteoric Hazards to Space Flight," by Dr. N. H. Langton, M.Sc., A.Inst.P.
Feb. 5. Kronfeld Club: "The Oxygen Story," by G. Melvill-Jones.
Feb. 7. Helicopter Association: "Wind Tunnel Testing of Helicopter Models," by M. S. Hooper, F.R.Ae.S.
Feb. 7. A.B.A.C.: Annual Dinner.
Feb. 10. Institute of Transport: Brancker Memorial Lecture: "Problems and Economics of Air Traffic," by A. Cdre. W. E. G. Mann, C.B., C.B.E., D.F.C.
Feb. 12. Kronfeld Club: "Flying and Motor Racing," by R. Flockhart.
Feb. 13. R.Ae.S.: Main Lecture: "Application of the Theory of Stability in Structural Design," by H. L. Cox, F.R.Ae.S.

R.Ae.S. Lectures (to Feb. 13):—

Jan. 18, *Birmingham*, "Airworthiness for the A.R.B.," by W. Tye. Jan. 20, *Halton*, Film Show. Jan 21, *Luton*, "New Methods of Approach to Airworthiness," by W. Tye. Jan. 23, *Isle of Wight*, "A Bush Pilot in the Far North," by R. J. P. Barber. Jan. 27, *Halton*, Film Show. Jan. 28 *Bristol*, "Aircraft Flight Systems," by Capt. A. M. A. Maiendie. Jan. 29, *Southampton*, "Flight Testing Procedures at Supersonic Speeds," by W/C. R. P. Beamont; *Weybridge*, Film Show. Jan. 31, *Chester*, Annual Dance. Feb. 3, *Derby*, A.G.M.; *Henlow*, A.G.M. Feb. 4, *Luton*, "Development of the Armstrong Siddeley Viper," by W. H. Lindsey. Feb. 5, *Brough*, "Supersonic Aircraft and Missiles," by P. J. Duncton; *London Airport*, "Noise," by Prof. E. J. Richards; *Reading*, "Ultra-Sonic Testing," by J. Crowther. Feb. 6, *Bristol*, "Design of Civil Aircraft," by D. P. Thorne; *Isle of Wight*, "Development of the Rotodyne and Gyrodyne," by D. M. Davies; *Swindon*, Lectures. Feb. 11, *Boscombe Down*, Film Show. Feb. 12, *Chester*, "Aircraft Fuelling Problems," by E. L. Bass. Feb. 13, *Cheltenham*, "The Microscope in Engineering," by A. E. Bingham; *Bristol*, Lecture.

Flight, 17 January 1958

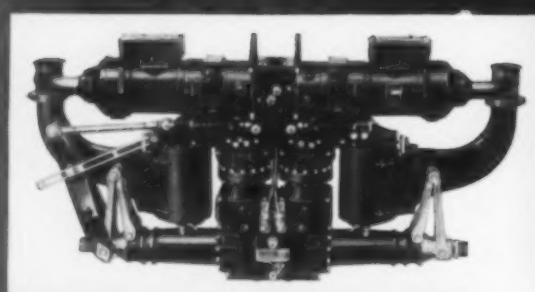


. . . across Europe in a Viscount behind

ROTOL PROPELLERS

PUB/R/45/57

Power Flying Controls by **Hobson**



HOBSON POWER FLYING CONTROLS are now being specified for a number of British aircraft including those incorporating "All-flying" or "Slab" tailplanes.
The unit, as illustrated, is a self-contained duplicated electro-hydraulic screw-jack type for operation of port or starboard ailerons.

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TOE-TOUCH SKID WARNING

A New Anti-skid Braking System from Goodyear

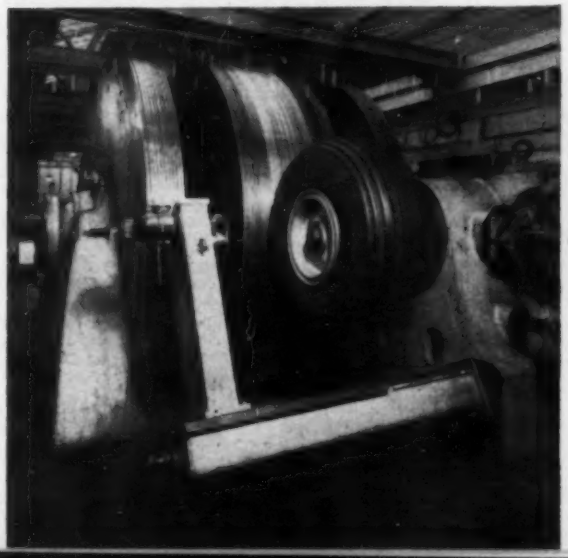
AT Wallasey, Liverpool, last week, the Goodyear Aviation Division demonstrated to their airline customers a new anti-skid aircraft braking system. It might be asked why, with established systems (Goodyear's among them) already giving very satisfactory service, a new method should need to be developed. The answer lies partly in a deficiency of automatic anti-skid arrangements—which are not under the direct control of the pilot—and partly in the obvious need for a cheap, simple device that can be fitted into an existing braking system (even a mechanical one) without extensive modification of the plumbing and hydraulic accumulator and tank capacity.

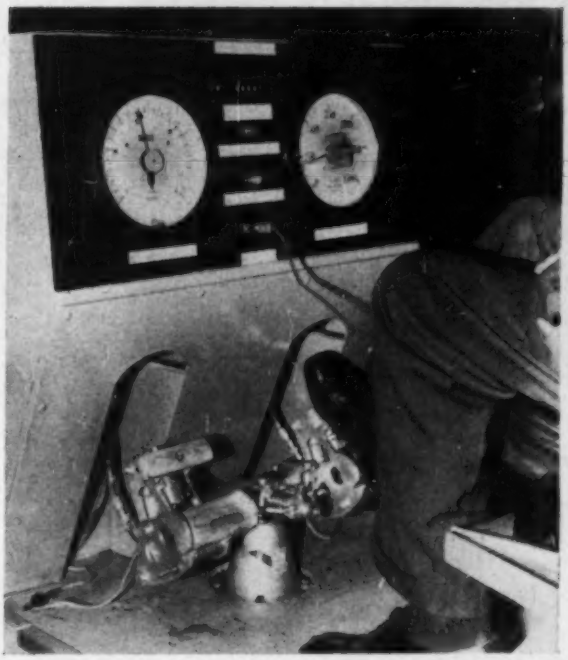
With present skid-control systems, unless the pilot exercises unusual judgment, say Goodyear, there is a tendency for over-braking and excessive wear of tyres and brake linings to occur. This statement requires some qualification, since at first sight it might seem that a skid-sensing device which off-loads brake pressure (and so prevents more than transitory skidding taking place) would provide the optimum braking at the wheel regardless of the maximum pressures applied at the pedal. Unfortunately, this can never be so. The pressure in the brake lines fluctuates widely and rapidly while the anti-skid control is in operation; the hydraulic pressure must be almost completely relieved once the wheel has momentarily locked, since in this condition it is static and not dynamic torque that must be applied to re-accelerate the wheel—and the mean value of these pressure fluctuations and of the braking effort applied may well be less (it can never be more) than the pressure for applying optimum braking. (Just *when* optimum braking occurs is still the subject of controversy, but it is generally accepted to be when the wheel is about to lock, at about 75 per cent slip between the tyre and the surface.)

To overcome this problem and the accelerated tyre and brake wear of unprotected systems, Goodyear have developed, over the past two or three years, a skid *warning* system that would tell the pilot when wheel skidding was about to occur—not an easy matter to judge when the cockpit is perhaps twenty or thirty feet ahead of the mainwheels. Work has been done both at Wallasey and by Goodyear in America, who used a Panagra DC-6B for tests of the warning device. Visual aids are of little help during the landing run, since the pilot's concentration is centred on the runway. The new system works through the rudder pedals, which incorporate "foot thumper" units vibrating against the sole of the pilot's shoe to remind him that a wheel is locking and that brake pressure should be relieved. This gives a pilot-reaction period, Goodyear say, that is two or three times faster than any other method yet suggested.

The system is quite simple and it is claimed that it can be incorporated with little modification into hydraulic, pneumatic or mechanical braking systems. There should be little complication in obtaining the approval of the various certification authorities. It can be used on its own, or incorporated into an existing skid-control system to prevent over-braking.

There are two main assemblies: a detector unit mounted in the axle of each mainwheel (regardless of number) and a skid indicator





Goodyear's "foot-thumper" demonstration rig. On the panel is a speedometer, related to the r.p.m. of the test dynamometer, a brake-line pressure gauge, a "runway-used" counter, and warning lights.

attached to each brake pedal. There is also an electrical control box. The detector unit consists of a D.C. generator enclosed in a cylindrical metal case energizing the indicator from the 24V D.C. aircraft electrical supply. The interior of the case is divided into a compartment containing the mechanical actuating and detecting mechanism and another housing a cam-operated micro-switch. A dog which is incorporated in part of the hub cap provides a positive drive to the detector unit. The normal characteristic of a D.C. generator provides an electrical voltage output substantially proportional to wheel r.p.m. The generator is connected to a series combination of a fixed capacitor and the coil of a polarised relay *via* a simple resistance/capacity filter network which eliminates any residual A.C. ripple in the generator output. The polarised relay is of the single-changeover-contact type with a central neutral position.

When there is a rapid change of wheel velocity a corresponding change of generator voltage causes a current flow in the capacitor/relay circuit. The magnitude of this current is proportional to the rate of change of voltage with time, and hence to the rate of change of wheel speed. The relay operates at a predetermined current setting, and in conjunction with the value of a series capacitor determines the rate of change of wheel speed to which the system is sensitive.

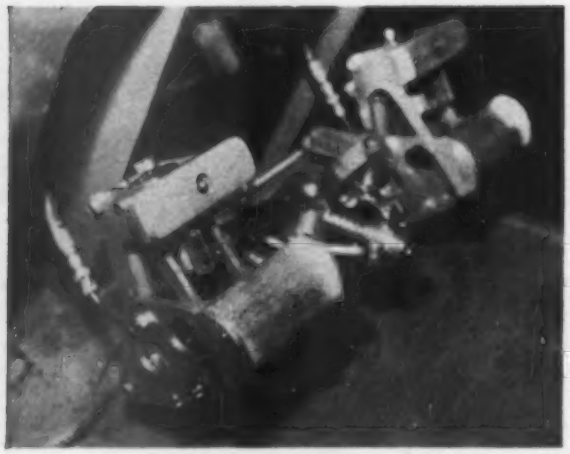
The changeover contacts of the polarised relay are arranged so that the coil of a second, general-purpose, relay is connected to the 24V supply when the decelleration of the wheel in skidding exceeds the preset level. The coil of this second relay is slugged with a large capacitor, so that even when the energizing voltage is removed by the return of the polarised relay changeover contact to neutral, the second relay remains held in for a short period. The second relay carries a single-make pair of contacts which, when closed, bring into circuit the motor of the skid indicator mounted on the brake pedal.

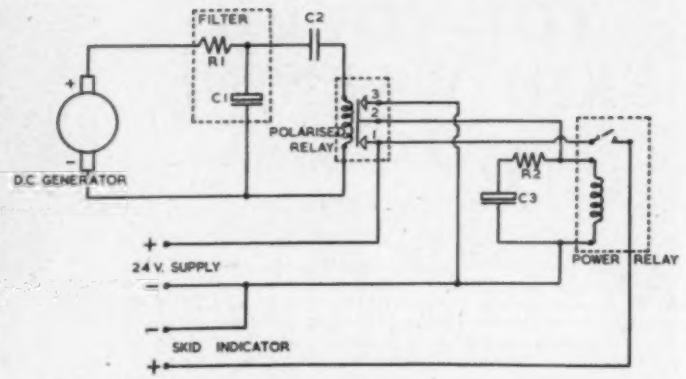
Acceleration of the wheel produces a rising voltage in the generator and a reversed current in the coil of the polarised relay.

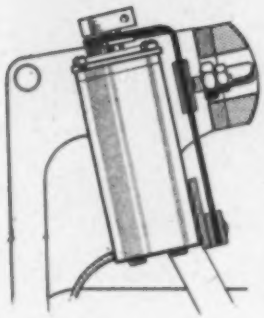
The flywheel of the 120in dynamometer (left) can simulate touch-down speeds of 200 m.p.h. Tyre loading is controlled from desks outside the cage.

Awful warning: the results (right) of locked wheels where skidding has not been prevented. Goodyear estimate that 50 per cent of tyres returned to them show signs of skid flat-spots or burns.

D







(Above, right) The electrical circuit of the new skid-warning system. (Above) The rudder pedals designed by Brooklands Aviation, which incororate the oscillated "toe-thumper" button. (Left) The electric motor, cam, leaf spring and thumper button. The electrical generating system is buried within the mainwheel axle of the aircraft.

TOE-TOUCH SKID WARNING . . .

The coil and capacitor of the secondary relay are switched to supply negative, discharging the capacitor and releasing the relay. This has the effect of cancelling any unused portion of the long hold-in period and thus switching-off the skid indicator motor, which will not then continue to operate when the wheel is rapidly accelerating (and requires early re-braking) after a skid.

The skid indicator is mounted upon the rudder pedals; it is a vibrator device consisting of a small D.C. motor running at 750 r.p.m. which, *via* a 4 : 1 speed changer and cam, oscillates a leaf-spring-loaded plunger at 50 c.p.s. It does not vibrate the pedal itself or affect the applied brake pressure. The indicator continues to "thump" against the pilot's foot until brake pressure is released.

To demonstrate the "foot thumper" skid-warning system, Goodyear had set up at Wallasey a dummy cockpit with a rudder bar and brake pedal of the S.B.A.C. type with built-in skid indicator units. The assembly, which can be seen in the heading photograph, is the prototype of a new Brooklands Aviation design. In front of the seat is a facia panel on which are mounted instruments showing brake hydraulic pressure and simulated airspeed, a veeder counter giving runway yards covered, and warning lights "prepare to brake" and "start braking."

Behind the pilot's seat is Goodyear's 120in Arrol dynamometer driven by a 400 h.p. electric motor. To the left and right of the flywheel are movable carriages and ram mechanisms upon which wheel, brake and tyre assemblies can be "landed" against the flywheel. For demonstration purposes, to make the wheel skid easily, ram pressures were limited to 3,000 lb; a condition in which wet rubber clings to the periphery of the dynamometer flywheel and reduces the coefficient of friction to about that of wet ice. A DC-6 and Bristol Freighter wheel assembly is used on the demonstration rig with a kinetic energy absorption of less than 2,000,000ft lb (this wheel is rated for use at K.E.s of 6,338,000ft lb). As a result, some care had to be taken to release the pedal completely when the foot thumper (which, by the way, does not tickle) comes into operation. The brake-line pressure indicator is blanked-off during a test, as the best pedal force to give maximum retardation without skidding can fairly easily be judged from the dial. To obtain the best results a certain amount of skill (as well as practice) is required; foot pressure needs to be regulated so that the thumper does not quite come into operation. If it does so, the coefficient of friction of the test undercarriage is so low that brake pressure must be relieved entirely for the flywheel to apply enough static torque to rotate the wheel and tyre; but to ensure shortest-distance braking the brakes must be applied again immediately.

These characteristics would not apply to the same extent for landings made in anything but exceptional runway conditions. Arranged as it is, the demonstration rig lends itself to some keen competition, and Goodyear have a "names and braking distances" board in the test house to add to the fun.

How quickly the system works is a function of pilot and system reaction time; the pilot may take about 0.3 secs to react and the wheel will then remain locked for about 0.4 secs. No damage to the tyre is done in this time.

One possible disadvantage of this skid warning system is that the warning is a negative arrangement: when the foot thumper operates, too much brake pressure has already been applied. But presumably the simplicity of the system would have to be sacrificed if, for instance, a secondary frequency vibration indication were provided. This might be operated at a lower pre-set capacitor/relay current to give warning that with any greater pedal pressure, the skid warning system would function. In any case, for the electro-mechanical scheme being developed as an alternative to the electrical system, such complication could not be incorporated.

The disastrous effect of skidding on aircraft tyres (Goodyear estimate that 50 per cent of all tyres returned to them are rejected because of flat spots and skid burns due to locking wheels) make an anti-skid system a wise safety investment. A system of the type described here may also show a return on increased tyre and brake life, since installation costs are said to be low. While specific examples cannot yet be quoted, for an aircraft of the Viscount type the cost might be £500—a sum that should quickly be re-couped in tyre savings by a short-haul airline. And in providing a skid warning system for non-hydraulic brakes, Goodyear are offering a service that has not been provided before. Perhaps the greatest advantage of the system is that skid control is under the control of the pilot.

BEECHCRAFT'S 1958 PROGRAMME

SALES of the new Beechcraft Travel Air are expected to total approximately $9m during 1958. This was announced at the company's recent international sales meeting at Wichita, when it was also disclosed that Timken Roller Bearing Company had brought "the world's first business jet"—the Morane-Saulnier MS 760, U.S. sales of which are handled by Beech under licence agreement with the French company.

Among the Beechcraft range of aircraft for 1958, the J35 Bonanza is powered by a six-cylinder Continental IO-470-C engine rated at 250 h.p. at 2,600 r.p.m. A simplified continuous-flow fuel injection system is used, and the pneumatically operated Tactair T-3 lightweight autopilot is among the optional equipment offered. Economical cruising speed (65 per cent power) is 195 m.p.h., and top speed is 210 m.p.h. Two versions of the Twin-Bonanza are being offered, the F50 (two supercharged 340 h.p. Lycoming GSO-480-B1B6 engines) and the D50A (two high-compression 295 h.p. Lycoming GO-480-G2D6 engines). Top speeds are respectively 240 and 214 m.p.h., and cruising speeds 228 and 203 m.p.h.

The new Model 95 Travel Air, now in full production, is designed to fill the gap between the Bonanza and the Twin-Bonanza, and is a four-seater powered by two 180 h.p. Lycoming O-360-A1A engines. It cruises at 200 m.p.h. and has a maximum speed of 208 m.p.h. It was first flown in August 1956 and received C.A.A. certification in June 1957. The remaining aircraft in the 1958 Beechcraft range is the Super 18 executive transport.

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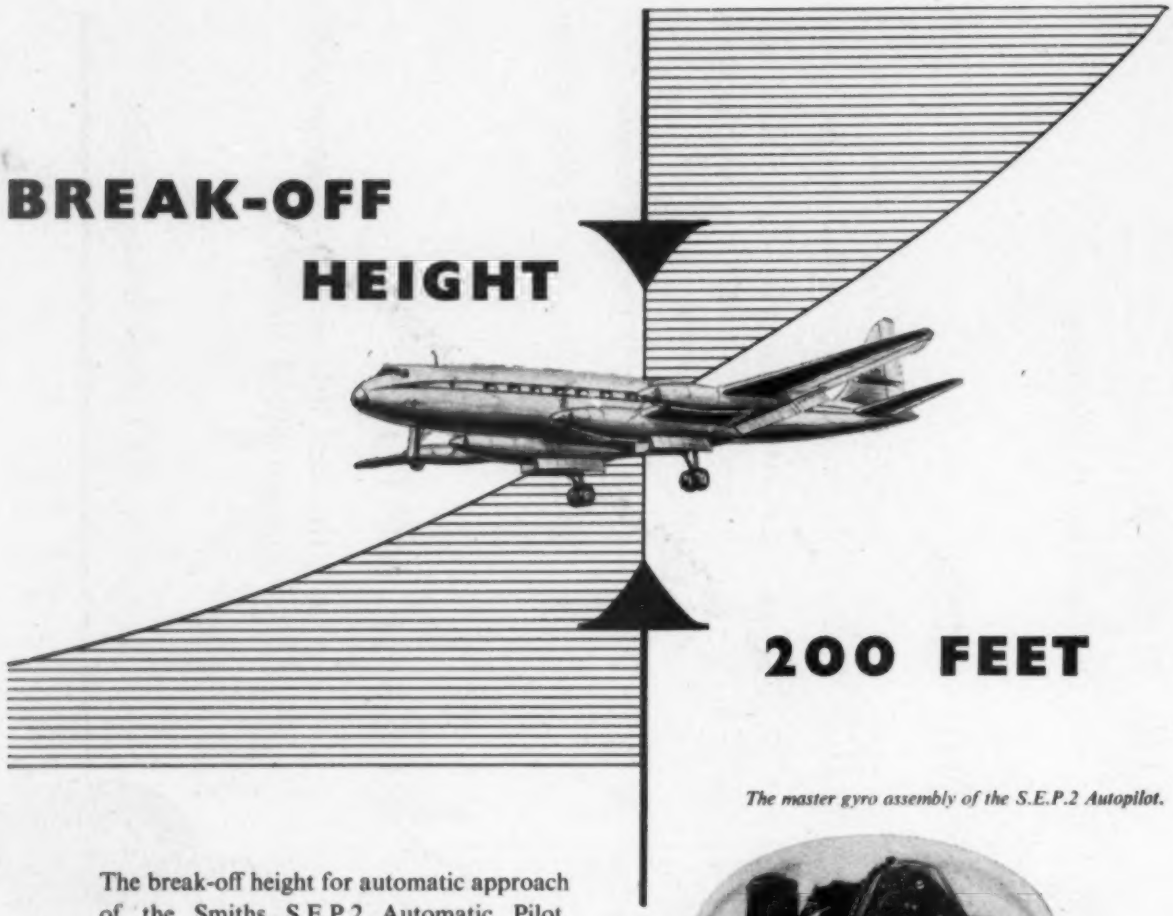
BREAK-OFF HEIGHT



200 FEET

The master gyro assembly of the S.E.P.2 Autopilot.

The break-off height for automatic approach of the Smiths S.E.P.2 Automatic Pilot, approved at 200 ft. by the A.R.B., is now the lowest figure for any civil Autopilot in airline service. By coupling to ILS or VOR beams the Autopilot permits precise automatic approach to a runway and reduces the number of missed approaches. Barometric height and speed control, pre-selected heading control and automatic elevator trim are other important safety features. The S.E.P.2. simplifies the pilot's task immensely when operating his aircraft through complex air traffic control patterns.

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TGA SM43R

The upper picture shows a Siebel Si 204D which has reappeared in German service. A number of these light transports—very popular with the war-time Luftwaffe—have been refurbished for German civilian use. The helicopter (or rather the elaborate helicopter mock-up) is the Kaman HU2K-1 ordered "in prototype quantity" by the U.S. Navy. Note the retractable undercarriage; the engine is a T58 (p. 79).

AIRCRAFT INTELLIGENCE

U.S.A.

Martin P6M SeaMaster. After twice losing a prototype through malfunctioning of the control system for the horizontal tail, Martin have designed a new empennage for the Seamaster which will be seen in a matter of days when the first re-engineered machine flies at Baltimore. There were originally 24 P6M-2s on order, but this quantity has now been reduced (first to 18 and now, it is believed, to 13). The production machines will have four Pratt and Whitney J75 engines and the new Sperry SP-30 transistorized flight system.

France

Dassault Méditerranée. It is reliably reported that there is "a good chance" that the Dassault Méditerranée jet-propelled executive aircraft will fly during 1958. It will have civil and military applications and will carry eight or nine passengers for 1,550 miles. Two low-power turbojets will be installed in under-wing pods.

Dassault Mirage III. The prototype of this mixed-power intercepter is still on test and ten pre-production examples are being constructed. Last year the first machine exceeded Mach 1.8 in horizontal flight. The pre-production aircraft will be fitted with the Atar 9 turbojet, and the production version—the Mirage IIIA—would be similarly powered.

Morane-Saulnier 1500 *Epervier.* This two-seat ground-support aircraft is shortly to fly. It will be equipped for the launching of air-to-ground missiles and will be initially powered with a Turboméca Marcadau turboprop of 400 h.p. Subsequently the Bastan of 750 h.p. will be installed.

Netherlands

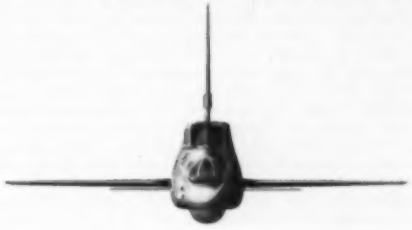
Hunter Production. Originally the Fokker company was to have built 460 Hawker Hunters—204 for the Netherlands and 256 for Belgium. The last machines of the contract will be delivered in 1959, but it is understood that the final 15 have been cancelled.

Japan

Fighter Equipment. The controversy as to which type of American supersonic fighter should be adopted by Japan's Air Self-Defense Force continues. Five types are on the list—the North American F-100D Super Sabre, priced at 250 million yen; the Convair F-102A Dagger, at 470 million yen; the Lockheed F-104A Starfighter, at 324 million yen; the Grumman F11F-1F Tiger; and the Northrop 156.

West Germany

Borgward-Focke-Kolibri 1. The foregoing is the designation of the first helicopter to be designed and built in the Federal Republic since the war. Powered with a 260 h.p. Lycoming engine, the new helicopter will carry the pilot and two passengers and will be adaptable for multiple roles. Speed is quoted as 100 m.p.h. Price is said to be between DM. 150,000 and DM. 200,000. A larger helicopter is being developed under the same auspices.



NORTH AMERICAN F-107A
(Pratt & Whitney J75)

Span	...	...	about 37 ft.
Length	...	...	about 62 ft.

Something New into Africa

By JOHN SEEKINGS

Airwork Viscount G-AODG about to take off from a sodden London Airport on the inaugural flight to West Africa on January 6.

THE author, a member of "Flight" staff, has just flown to Accra on the inaugural Viscount Safari flight to West Africa. Not only is the Viscount a novelty to West Africans, but its use on this route poses a wide range of operational and commercial problems to the two independent British airlines, Airwork, Ltd., and Hunting-Clan Air Transport, Ltd., that participate jointly in this service. His discussion suggests how complex is the background to airline operation. In the case of West Africa these problems are heightened by the rapid movement towards political independence—a movement signified in the civil aviation field by the increasing desire of each emergent State to stake a bigger claim in its national air transport.

HANDING a South African passport across the counter to the Ghanaian Immigration Officer at Accra, I wondered whether my reception would be a cordial one. There was no need to worry. The officer spread his arms in a wide gesture of greeting and, grinning broadly, proclaimed "First turboprop Viscount? Welcome to Ghana!"

Shortly before landing at Accra we were addressed on the loudspeaker by the Ghana High Commissioner, who was travelling, together with a party of his London colleagues, on this inaugural flight. His Excellency reminded us that Ghana was proud to be served by the first turboprop aircraft to fly into West Africa, and congratulated Airwork and Hunting-Clan for jointly providing such a useful and comfortable service.

Airwork Viscount G-AODG was not, in fact, the first turboprop airliner to appear in West Africa. An executive Viscount owned by the Standard Oil Company has recently been seen flitting through various airports in this region. The only other turbine airliner previously in West Africa was the Comet 2 used by U.A.T. on a short-lived jet service between Paris and Dakar.

Seen from a British viewpoint, the new Viscount Safari service to West Africa is of even greater significance. It represents the first occasion on which an independent British airline has flown an international route with the very latest equipment on a scheduled tourist-class service. Until last summer, the independent companies were restricted to less modern aircraft on intercontinental routes. Since then the use of Viscounts has been permitted on colonial-coach services to East and Central Africa. Translation of a colonial Gold Coast into an independent Ghana has meant that the route to West Africa which was domestic is now international, and so the colonial-coach class service ceases to apply. Although third-class fares are about to be introduced on the North Atlantic, no arrangements have yet been made by the International Air Transport Association for the introduction of such fares on other international routes. Until such arrangements are made—probably within the next two years—the third-class fare offered on the West African Safari service since 1954 must disappear. Fares have accordingly been increased to bring them in line with those offered by B.O.A.C. on trans-desert services. For the same fare a tourist-class passenger travelling between London and Accra has the choice of a B.O.A.C. Argonaut *via* Kano, Tripoli and Rome, or a Safari Viscount *via* Freetown, Bathurst, Las Palmas and Lisbon. The faster cruising speed of the Viscount allows the flying time on the coastal route to be slightly less than that of the Argonaut on the 400-mile shorter desert route. But whereas B.O.A.C. passengers travel day and night, Safari passengers only fly by day, spending the night at Las Palmas. Accra tourist-class passengers can choose between Safari comfort or B.O.A.C. speed.

This emphasis on enjoyable rather than rapid flight has always been the hallmark of Safari services, and it has never been better expressed than on this new service to West Africa. In the hot turbulent weather conditions typical of this part of Africa, the restful comfort of the higher-flying, vibration-free, air-conditioned Viscount can be really appreciated. This in-flight comfort, together with the relief of spending the night in a soft bed on *terra firma*, ensures that the passenger reaches his destination in somewhat better shape than is normally the case after indulging in long-distance air travel.

Airwork and Hunting-Clan are also particularly glad to see the Viscount on their West African route. Previously flown with Vikings, this service was never very rewarding to its operators. Impending statutory introduction of weight, altitude and temperature (WAT) limitations for the Viking would have affected this route severely. A drastic reduction in payload from over 25 to under 20 passengers could only have been avoided by effecting costly modifications. In either case, this particular route would certainly have ceased to be an economic proposition. As it is, the basis upon which the Safari services are operated was altered in June 1957, when the Minister of Transport and Civil Aviation, Mr. Harold Watkinson, consented to the use of modern aircraft on these routes.

Choice of machine was affected by factors additional to the basic objective of maximum profitability. Early availability was essential. Aircraft size would be limited by the need to avoid unacceptably low flight frequency. It had to be well proved, if possible under similar conditions to those under which Safari services operate. Furthermore, the possibility of losing capital in the event of having to re-sell the aircraft had to be considered at a time when political uncertainty coincides with plummeting second-hand aircraft prices. In these circumstances the Viscount was clearly the most suitable vehicle. Hunting-Clan recalled three Viscounts from Lebanon, where they had been flying under the colours of Middle East Airlines. The two Viscounts purchased by Airwork from the Norwegian independent, Olsen Air Transport,

A visiting Secretary of State for the Colonies once remarked that Ghana appeared to be completely covered with asphalt. This work was necessary to protect runway verges from erosion, but it is not typical practice in a region responsible for much original research on soil mechanics.

The passenger terminal and control-tower at Accra airport.

had previously been leased, one to M.E.A., and the other to British West Indian Airways.

A fleet of five Viscounts is admirably fitted to the requirements of the Safari services. Schedules contemplated for flights to West, East and Central Africa will provide at least 2,000 hours p.a. for four of these aircraft, leaving the fifth as a reserve. Schedules have been drawn up to allow a high proportion of Safari flying to take place on weekdays, permitting each airline to accept week-end charter flights, particularly inclusive-tours.

Such high utilization and week-end availability have been prohibited in the past by the Viking's slower speed and shorter maintenance cycle. (It was possible for the Viking to complete only one Safari flight between Check 1s, whereas the Viscount can cover two, soon probably three, flights before requiring a routine check.) Viscount Safari schedules normally allow for an average ground time of only 30 minutes, as against an allowance of 45-60 minutes for most long-distance operators. The problem of speeding up ground handling and refuelling procedures is much in the minds of airlines about to acquire expensive modern aircraft. The Safari service provides an example of an airline already tackling this problem. With the Viscount, refuelling rather than passenger handling is the main delaying factor. Until high-speed pumping facilities (100 gallons per minute at least) are available all along the route, it will not be easy to maintain the anticipated 30-minute limit. The operators also seek high crew utilization, subject, of course, to statutory limitations. These stipulate, among other conditions, a maximum daily duty time of 16 hours for each member of the crew, followed by a rest period of the same duration, subject to a minimum of 10 hours. Viscount Safari schedules are so arranged that costly crew-slipping is avoided. A disadvantage of this method is that crew restrictions might prevent the aircraft from making up lost time. The operators believe that their policy of basing schedules on a cautious appraisal of meteorological conditions and on employment of moderate cruising techniques (an important factor in reducing maintenance expenditure) results in sufficient "slack" in the timetable to allow lost time to be retrieved in the air rather than on the ground.

The fact that no other Viscounts are being used on this route south of Lisbon makes it necessary for the organizers of the Safari service to arrange their own maintenance. In the early stages of the service a flight engineer will be carried on board. Later it is planned to station ground engineers down the route. On a service of such low frequency as this—once weekly in both directions—stationing of staff away from base is an expensive arrangement. For this reason appointment of handling agents is preferred to employment of the companies' own traffic officers. Not only is this reckoned to be cheaper, but the local experience and useful contacts upon which the agent can draw probably places him in a better position to carry out his handling functions.

The West African Safari service is no exception to the general rule that the nature of air traffic changes with each individual route. A particular feature of this service is that a remarkably high proportion of passengers buy one-way tickets only. This is attributed to the large number of persons who fly to and from West Africa at the start and finish of their term of duty. There are two likely reasons why this should be so. First, as sea fares to West Africa are very high in relation to air fares, a large section of traffic normally expected to travel by sea in this case chooses to go by air. Second, as terms of duty are (for climatic reasons) short, persons sent out to West Africa often return with less personal property than is generally the case, and are, therefore, less tempted by the low baggage-rates offered by shipping companies. Another feature is the preponderance of passengers travelling alone. A quick perusal of advertisements for vacant posts in West Africa provides the clue to this: the vast majority appear to be for single men and women. Married quarters are limited.

The distinct nature of this traffic is reflected in various ways. Seasonal variations are less pronounced than on most routes. West African passengers travel according to the dictates of their appointment-contract rather than to the whims of the British summer. The colonial-coach Safari services to Central and East Africa attract, in contrast, a high proportion of family traffic which tends to travel to the U.K. in the spring, returning to Africa in the autumn, thus giving the carriers quite a headache in trying to find return loads.

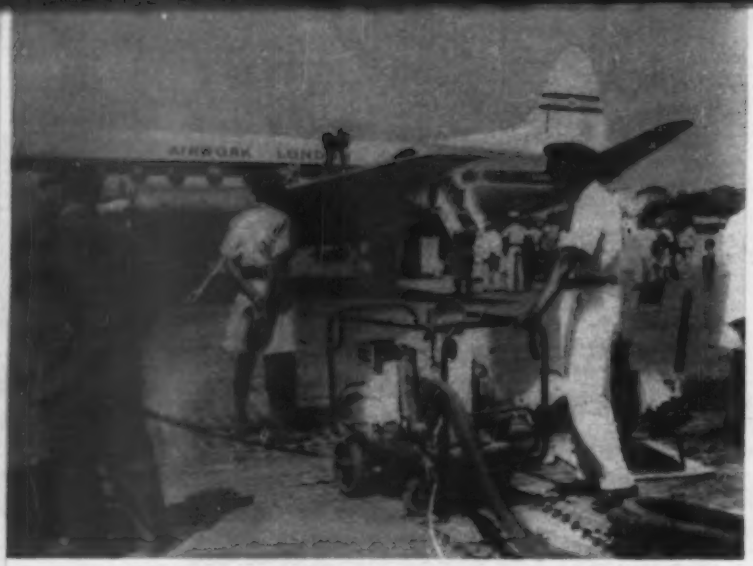
The nature of this traffic is also reflected in a higher revenue rate than would otherwise be the case. Fares between Europe and West Africa are based upon trans-desert distances. As the Safari Viscounts follow a longer course around Africa's coastline, the fare —expressed in revenue per passenger-mile—would be rather low were it not for the high proportion of passengers who pay the full adult one-way fare. Revenue rates are not diluted by the usual number of round-fare rebates or off-season and family concessions.

But not all the features of this traffic are to the advantage of the carrier. A fairly large number of passengers travel only as far as the Gambia or Sierra Leone. Consequently, the long terminal sector between Freetown and Accra is flown at a low load-factor. On a 4,200-mile route a light load over a 900-mile sector is a serious matter. Yet this is an exaggerated example of a problem faced on most long-distance services. The normal solution is to find sector traffic to fill the empty seats. In the days of Viking operations this was not easily accomplished, but the Viscount is so superior to current competing equipment that this problem should now be much less acute. Although traffic rights for points in the United Kingdom and West Africa have already been negotiated, rights for traffic to and from Las Palmas and Lisbon are still under discussion.

Seats do not sell themselves. If passengers are going to travel on the Safari service they must be "sold" the idea, and selling effectively to the prospective clientele on this service is unusually difficult. Those many passengers buying only single fares must be "sold" the return journey. To gain the attention of those serving a tour of duty in West Africa is not too difficult. A popular sales representative, together with a selective sales campaign, will mean that very few expatriates need be unaware of Safari turbo-prop travel. But to reach the notice of the appropriate section of the British public is a more difficult operation. Advertisements in the mass circulation media, while probably being very effective, are certainly highly expensive, if not exorbitant in view of the small number of seats to be sold. A more direct method is indicated, such as keeping in close touch with the commercial houses and other organizations that are known to have interests in West Africa, or by tactfully following up advertisements in "situations-

This arch, commemorating the independence of Ghana, was recently erected in Accra.

Lisbon provides a convenient European gateway for the West African Safari. Of 258,000 passengers passing through this airport on all services in 1956, 102,000 were in transit.



(Left) The first turbine airliner on scheduled service to be refuelled in British West Africa. Pending arrival of high-speed pumping equipment, a temporary refuelling unit has been devised by linking a submerged 2,000-gallon tank with a portable 60 gal/min pump.

It must be unusual to see a modern 30-ton airliner operating scheduled services through an airfield paved with P.S.P. (pierced steel planking). This is a close-up of the Viscount 700 nose-undercarriage at Bathurst.

SOMETHING NEW INTO AFRICA . . .

vacant" columns of relevant British newspapers and magazines.

Quite different advertising problems are posed by the African public. Since independence there has been a considerable increase in the number of Ghanaians travelling to Europe. Many of these have never before left West Africa or even flown. West African Airways' posters suggest some possible paths worth exploring. Obviously, any people shown in advertisements should not be Europeans; some air passengers are depicted carrying books of learning, suggesting that educated people travel by air; airliners are shown in remote places, disgorging happy peasants and traders, implying that there is nothing special or disquieting about air travel; the convenience, speed, safety and cheapness of flying is emphasized. But advertisements such as these are probably better framed for tempting the uninitiated to use local services than for getting traffic on to the London-bound Safari Viscount. Most of the Ghanaians going abroad are associated with the Government in some way and so it is, therefore, possible to approach them on a selective, direct basis. Establishing and maintaining close liaison with government departments appears to be a particularly useful technique. But once Ghana establishes her own air service to Europe this will not, of course, be so straightforward.

Shortly after Ghana achieved independence last year, it became apparent that Dr. Nkrumah and his cabinet were anxious to form a national airline. During summer and autumn negotiations continued with a number of carriers which had come forward to offer their assistance. By December the list of contenders had been reduced to three, B.O.A.C., K.L.M. and W.A.A.C. The Minister of Communications, the Hon. Yeboah Afari, paid a flying visit to Europe to review the situation and returned to Ghana early in January, presenting a report to his cabinet in which the respective schemes put forward by each airline were compared.

The Ghana High Commissioner in London, E. Asafu Adjaye, disembarking at Bathurst during transit.

The basic requirement of the Government is to create a national airline in which Ghana will have a majority shareholding, and in which the "partner" must have a sufficiently large share to ensure its being keenly interested in achieving satisfactory financial results. Unless W.A.A.C. was selected—which is unlikely—no share would be held in the new carrier by W.A.A.C., or by the Nigerian Government. The principal operation of the Ghana airline would be a trans-desert service between Accra and London. No other long-distance services are contemplated, except possibly to the Middle East. Regional services would be operated, starting initially between Accra and Lagos, in competition with W.A.A.C. Ghanaians feel that W.A.A.C. have lacked initiative in developing internal services. At present only Takoradi, Kumasi and Tamale are linked with the capital. It is the Government's intention to expand other internal services, not necessarily at a profit, as rapidly as possible. Large-scale capital commitments are to be avoided by chartering aircraft to operate the longer routes. For the shorter routes, a choice must be made between spending money on expensive aircraft and inexpensive runways, or on cheaper aircraft together with costly landing facilities. An important section of the final contract will cover details for as complete an "Africanization" of the airline staff as is compatible with efficient operation.

On purely economic grounds, B.O.A.C. is well placed. It has unrivalled experience on the particular route in question. It has suitable aircraft available for charter. It is better placed to negotiate traffic rights between Ghana and the U.K. But its case is weakened by the very fact that it is British. Ghanaians have also noticed the recent improvement on services to their country and suspect that this change only came when B.O.A.C. realized that its hand would be forced.

The Cabinet will probably reach a decision by early February at the latest, for it is planned to begin operations by the summer.

In Sierra Leone this trend towards independence in air transport is also evident. Largely through the initiative of the Governor, Sir Maurice Dorman, Sierra Leone Airways is in the process of being formed. The Government of Sierra Leone will own all or most of the shares. Three D.H. Rapides have already been purchased from B.E.A. This plan still awaits approval from the Executive and Legislative Councils, but should be agreed by the spring. The object behind the formation of Sierra Leone Airways is to facilitate administration of a country which, although small, is badly served by surface transport. A sad little song tells of the unhurried railway service running inland from Freetown to Bo:—

The train to Bo
She no agree for go:
The engine she done tire
For lack of plenty fire:
The train to Bo
She no agree for go . . .

To reach the outer villages of Sierra Leone at present takes at least three days travelling overland from Freetown. Rapides will cut this journey-time to as many hours. Unlike the proposed Ghana airline, Sierra Leone Airways have drawn up a management agreement with W.A.A.C. Mr. D. Malcolm Brown, general manager of W.A.A.C., is expected to be S.L.A.'s chief executive.

Government officials in the Gambia appreciate the advantages which air transport will bring to Sierra Leone and unofficial plans have been put forward for opening air services between the capital, Bathurst, and points up-river. Georgetown would probably be the inland terminus for this service.

* * *

As the Airwork Viscount approached Bathurst on its inaugural flight, Captain Woolfe was asked by the air traffic controller whether he would oblige the local inhabitants by orbiting the airport, and thus give them a good opportunity to appreciate this great new aircraft. Nothing could better illustrate the growing interest that West Africans are taking in air transport.

Fairey flies the first Vertical Take-off Airliner

Adding achievement to achievement, Fairey Aviation have now built potentially the most important transport aeroplane in the world, the Fairey Rotodyne.

Carrying 48 passengers or 4½ tons of freight it takes off vertically as a helicopter and having gained height flies forward as a normal twin-engined airliner.

It is the most adaptable rotary-wing aircraft in the world and the first to offer operating economy directly comparable to that of fixed-wing aircraft over ranges of up to 400 miles.

The arrangement within the Rotodyne's capacious fuselage can readily be adapted to suit civil or military applications.

Powered by two Napier Eland propellor-turbines with Fairey Pressure-Jets at the rotor-tips for take-off and landing.

FAIREY *Rotodyne*

48 passengers · 185 m.p.h. cruising speed

400 miles maximum range.

THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX

ENGLAND · AUSTRALIA · CANADA

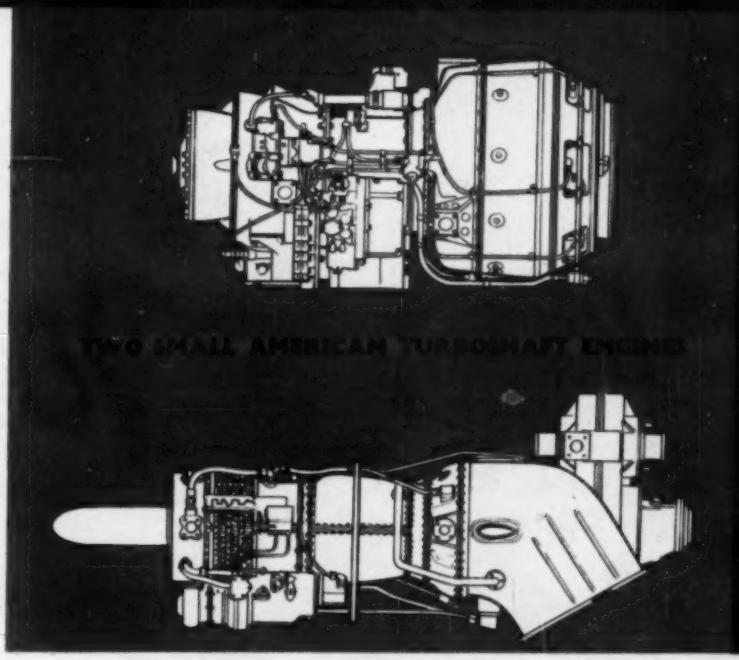
DE HAVILLAND ENGINE RESEARCH SPEEDS THE WAY AHEAD

For optimum efficiency at high supersonic speed, the air-intake—no longer a simple engine component—itself requires considerable development effort.

Wind tunnel research undertaken by experienced de Havilland technicians in the Engine Company's laboratories provides precise aerodynamic information for the design of intakes with high pressure-recovery factors.

DH ENGINES

GYRON GYRON JUNIOR SPECTRE



TWO SMALL AMERICAN TURBOSHAFT ENGINES

T53 and T58

IT is natural that, during the first twenty years of its existence, almost the entire effort applied to the development of the aircraft gas turbine should have been expended on large units of maximum military significance. The U.S.A., in particular, seriously misjudged their overall effort and concentrated on big turbojets to the detriment of other types of engine. To make up for this deficiency all three of the American armed services are sponsoring a variety of new gas turbines, and two of these are shaft-drive ("turboshaft") units in the 1,000 h.p. class.

One of these is the T53, by Avco's Lycoming division at Stratford, Connecticut; the other is the T58, by General Electric at Evendale, Ohio. This is an opportune time at which to review their characteristics and history—particularly as one of them, the T58, has been seen in Europe already and may become widely employed in aircraft outside America.

General Electric actually made a very early attempt at producing a turboprop in 1945, with the TG-100 (XT31). This engine seems to have damped their enthusiasm for shaft-turbines for a whole decade. In contrast the T58 is a most competitive unit. The design won a U.S. Navy BuAer competition in 1954 and we published a picture of the mock-up on April 9 of that year. In conceiving the engine G.E. said to themselves, "for commercial success we must produce an advanced and sophisticated engine with a superior brochure performance; it will be a 'clever' little unit, posing severe problems, but we are a large and rich company and will make it work." This contrasts with Lycoming's philosophy, outlined later.

Basic design features of the T58 can be deduced from the data panel and cut-away drawing overleaf. The following is the text of a paper read in New York last month by Mr. M. N. Davis, evaluation manager for the T58, of the company's Small Aircraft Engine Department, who are located at the original G.E. gas-turbine establishment at Lynn, near Boston, Mass.

The T58 engine [states the paper] was developed by General Electric and the Navy's Bureau of Aeronautics to fulfil helicopter requirements for a gas-turbine engine in the 800-1,500 horsepower class. The helicopter industry had for some time been investigating engine power and operational requirements to determine the most desirable gas turbine powerplant. Through these investigations, certain basic requirements were found to be essential to high performance helicopter operation: low s.f.c.; high power/weight ratio; durability and reliability; and stable, selective constant-speed control.

It was not until the later phases of these investigations that the final T58 configuration was determined. Consequently, engine performance guarantees were selected which appeared to give adequate margin for horsepower, specific fuel consumption and engine weight, but which would also allow a design capable of extremely fast power response, durable and simple to service and overhaul. At this point in the T58 development calendar, minimum performance *guarantees* were established for the first production model:—

	h.p.	*s.f.c*
MIL (take-off)	1,024	.66
Normal rated power	875	.69
90 per cent NRP	787	.72
75 per cent NRP	656	.77

Weight, 335 lb (including reduction gear)

The first group of 22 flight-test engines built for helicopter development had an average performance of 1,060 h.p. and 0.65 s.f.c. at MIL power; some of these engines delivered more than 1,100 h.p. and operated at an s.f.c. of 0.63. The average weight of these engines was 324 lb.

The T58 is a free-turbine design. The ten-stage axial compressor, the combustor, and two-stage turbine comprise the gas-generator portion of the engine. This unit can be operated as a separate engine and, if a tailcone is installed rather than the power-turbine assembly, it becomes a conventional jet engine. We have used this configuration for field testing, such as anti-icing tests on Mt. Washington, which allowed us to run the gas generator to full power with no rotor or dynamometer to absorb the load. Military personnel may desire to use this feature for checking engines after major field repairs.

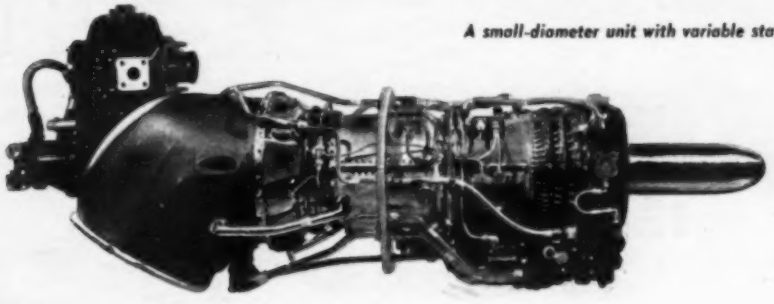
The free power-turbine assembly uses a single stage to drive the output shaft. The power turbine operates at very moderate temperatures and normally need not be removed from the helicopter at engine change, since its life between overhauls should be substantially greater than that of the gas generator. The engine accessory section, including control, fuel and lube pump is driven by the gas generator.

The constant-speed control is set by a cockpit lever which allows the pilot initially to select any desired rotor speed; thereafter, the control will automatically adjust gas-generator speed to maintain rotor r.p.m. During development we also learned that the control will maintain power-turbine or rotor speed when the engine has suffered certain types of internal damage. In this case the gas generator will automatically increase speed as required.

The T58 engine has now (December) accumulated 6,000 hr of development and operational testing: factory development testing, 5,000; helicopter rotor operation, 700; other testing, 300. Two helicopter manufacturers, Sikorsky and Vertol, are currently conducting flight-test programmes on helicopters each using two installed T58s.

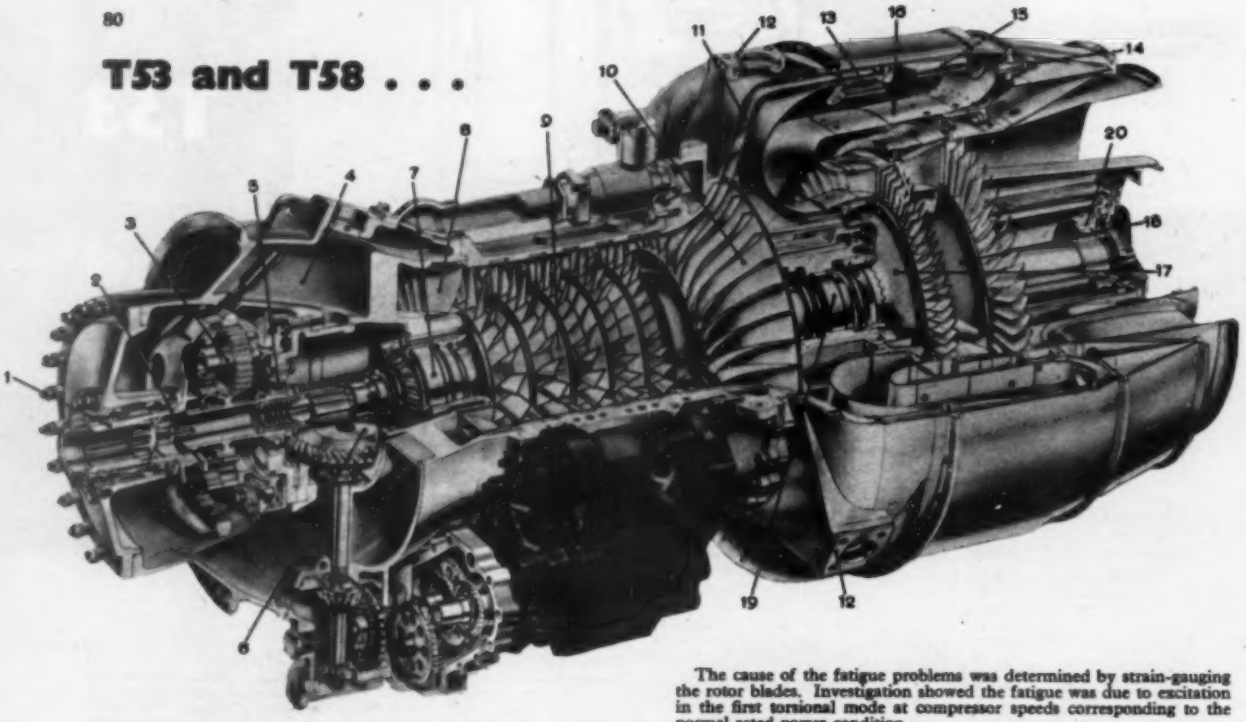
Engines currently operating in flight-test programmes are built to the

A small-diameter unit with variable stators, the T58 is seen below from the starboard side.



General Electric T58. Free-turbine engine for helicopters. Ten-stage compressor with variable incidence on the inlet guide vanes and succeeding three stator rows, annular combustion chamber with 16 injectors, two-stage compressor turbine, single-stage power turbine and reduction gear at rear end. Basic diameter at the maximum flange, 16in; intake diameter; 11.4in; height as depicted, 27.3in; basic power-section length, 39in; length as depicted, 71in; dry weight, 250 lb or 325 lb with reduction gear; mass flow and pressure ratio, restricted; maximum rating, 1,024 s.h.p. (1,050 without reduction gear) at 19,500 power-turbine r.p.m.; maximum continuous cruise rating, 875 s.h.p. with s.f.c. of 0.69.

T53 and T58 . . .



configuration that accomplished the 50-hr test in August of 1956. The first shipment engine was returned to the factory for overhaul after having accumulated 135 hours of testing. We were pleased with this performance of our first delivered engine, particularly in view of jet experience where initial engines are returned with substantially fewer hours.

Since this 50-hr engine had already demonstrated production specification requirements for horsepower, fuel consumption and engine weight, the outstanding requirement for 150-hr acceptance was to obtain durability of engine parts and improved power control stability margins. I would like to discuss a few of these improvements in some detail.

After accumulating 2,500 hours of engine testing using 12 compressor assemblies, some with over 300 hours operating time, an interesting design problem was encountered with some of the rear-stage compressor rotor blades. After this extended amount of testing, the rear stages in several compressors began to exhibit a fatigue condition in the dovetail. On the three occasions in which blades cracked, only one of the failures resulted in complete separation of the blade and dovetail. The engine data sheets disclosed that the engine operated for eight hours on military specification test schedule after the failure occurred, and before the damage was suspected. A change in compressor efficiency was noted when the data was processed by the analytical group—the personnel operating the engine were not aware of any power change or mechanical malfunction at the time. The stage of blades was removed and a new set installed without removing the engine from the test stand. The test was back on schedule within 24 hours, and an additional 130 hours of cycle testing was accumulated without further difficulty.

The cause of the fatigue problems was determined by strain-gauging the rotor blades. Investigation showed the fatigue was due to excitation in the first torsional mode at compressor speeds corresponding to the normal rated power condition.

In every development manufacturing programme, the shop personnel must learn how to make the new parts which, in many cases, are significantly different from similar parts previously designed for older engines. Initially, the parts may vary substantially from the dimensions and tolerances established by the design engineers. Our attention was initially focused on the improvements being made in rotor-blade dimensions when it became apparent that the test engines were delivering 50-100 h.p. more than was obtained when using compressor blades manufactured earlier in the programme. The shop improvements in obtaining design limits for thickness and contour changed the mass and vibration characteristics of the blades. When these blades were excited by a pulsating load such that it twisted torsionally, we discovered the dovetail would break when the natural frequency was obtained.

Anyone familiar with small high-speed compressors can appreciate the problem in developing suitable blade strain-gauge instrumentation. At the start of the T58 programme, an attempt was made to strain-gauge the rotor blades using an adaptation of a slip-ring assembly developed and built in Germany. However, because the assembly was not designed to operate at the 27,000 r.p.m. speed of the T58, and with corresponding lubrication and vibration characteristics not compatible with this slip-ring design, it was impossible to get the micro-volt signals from the gauges to the oscillograph recorders. Since no blades were breaking, testing was continued and the instrumentation designers went to work on a slip-ring designed specifically for small-engine applications. Fortunately, they came up with a design that worked and was available at the time the fatigue phenomena occurred.

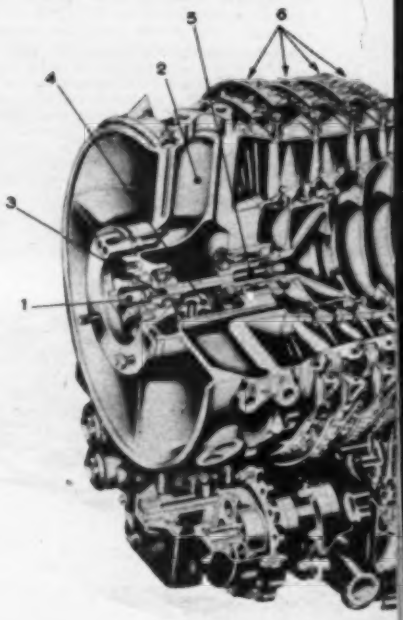
A potentially important feature of the compressor has been demon-

T53 (above)

1 Drive shaft and ball bearing
2 Roller bearing
3 Planetary reduction gear
4 Heated intake casting
5 Main ball bearing on independent power shaft
6 Accessory drive bevel
7 Compressor front bearing
8 Fixed inlet guide vanes
9 Five-stage axial compressor
10 Centrifugal compressor
11 Diffuser air path
12 Powerplant mountings
13 Secondary cascade
14 Fuel injector
15 Walking-stick vaporizing burner
16 Reverse-flow chamber
17 Compressor turbine (overhung)
18 Power turbine
19 Compressor-shaft rear bearing
20 Power-shaft rear bearing

T58 (opposite)

1 Starter drive clutch
2 Heated intake casting
3 Stub-shaft bearing and accessory drive bevel
4 Accessory drive
5 Compressor front shaft and roller bearing
6 Variable stators
7 Ball thrust bearing
8 Annular chamber
9 Dual fuel gallery
10 Two-stage compressor turbine
11 Rear roller bearing
12 Power turbine
13 Output roller bearing
14 Main ball bearing
15 Bifurcated exhaust duct
16 Exhaust duct
17 Inner wall of duct
18 Duct bracing strut
19 Idler pinion
20 Final drive shaft



strated during field operation. It has generally been standard practice to rebalance and high speed a compressor rotor when a set of blades in any stage has been replaced. Military personnel have been telling engine manufacturers for years of the desirability of accomplishing compressor-blade replacement in the field. We have discovered that in addition to replacing compressor rotor blades in the factory test cells, we can change up to three complete stages in the field, with no detrimental effects on either performance or vibration. First-stage blades and blades in the rear stages have been replaced without removing the engine from its mount. This feature enabled us to accomplish a great deal more field service on the T58 than was possible with older engines.

Major improvements were made in combustor durability between the 50 and 150 hour tests. Early liners showed the results of inadequate temperature distribution. Deterioration was gradual and resulted in general collapsing of the structure with resultant hot spots or blisters occurring on the combustor casing. Due to experience gained on development in other production engines, and the extremely conservative gas temperatures used in the T58, the design objective was to develop a liner whose service life would equal the allowable operating time of the engine between overhauls.

The compressor diffuser and combustor liner were explored as a related single problem. Although it doesn't look greatly different from the previous liner, the improved pattern has seven major modifications. Positive distribution of primary and secondary air flow was achieved at the exit from the compressor. The cowl has been redesigned. The positioning of the liner in relation to the diffuser and combustor casing is more precise. The position, area and number of louvres and holes have been changed. Overall length and expansion provisions have been modified. The result is a liner insensitive to all but the most extreme cases of fuel-nozzle failures. One of these liners has now accumulated 330 hours of testing to the test cycle schedule, and shows no deterioration.

Fuel controls and associated engine control parts have historically been a major development problem. Helicopter rotor systems and drive shafts pose a far more severe problem to constant-speed control than does the propeller. The flexibility of rotor blades and their lag hinge attachments create a very elastic load, further aggravated by the backlash in the numerous gears of the transmission and reduction gears. The twist of the drive shafts increase the elasticity even more. The time constants of elastic rotor systems make it difficult for the engine control to sense the actual speed and load of the rotor blades.

Computer studies coupled with rotor test-stand investigations helped us minimize the problems. The specific troubles of the first controls were that they had insufficient stability margin and did not permit consistent automatic engine starting. We are retrofitting our field engines with an improved fuel control. The improved control accumulated 1,250 hr of accelerated cyclic testing prior to initiation of the Model Test. A total of 15,000 hr bench testing was accumulated in the development programme; 15 controls were used prior to initiating the Model Test, and more than 4,000 engine hours were obtained.

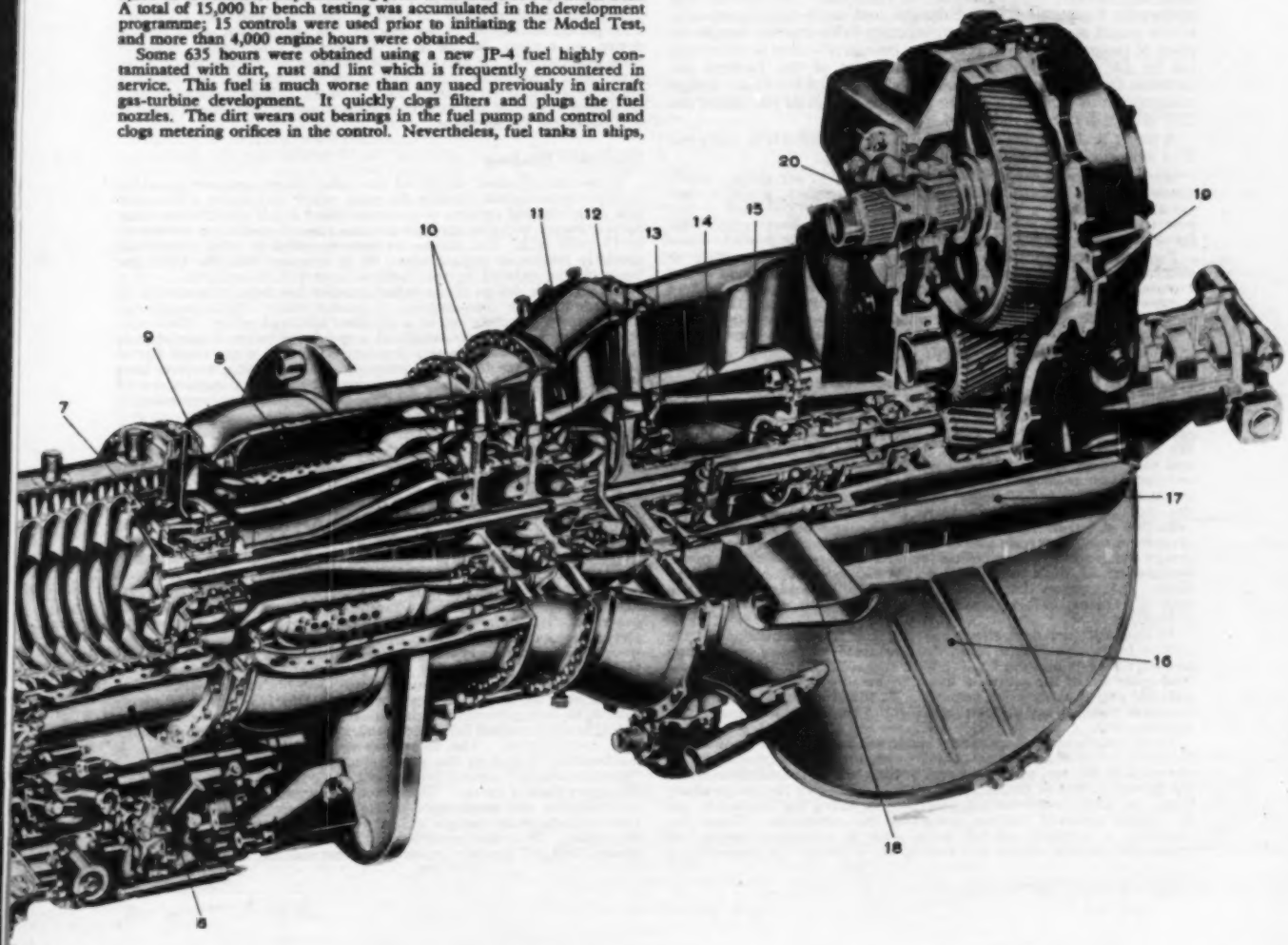
Some 635 hours were obtained using a new JP-4 fuel highly contaminated with dirt, rust and lint which is frequently encountered in service. This fuel is much worse than any used previouly in aircraft gas-turbine development. It quickly clogs filters and plugs the fuel nozzles. The dirt wears out bearings in the fuel pump and control and clogs metering orifices in the control. Nevertheless, fuel tanks in ships, tankers, aircraft carriers, etc., gradually accumulate such dirt. Since the majority of the fuel used in the world is transported by ship, aircraft engines must be capable of operating on the fuel without the necessity for filters.

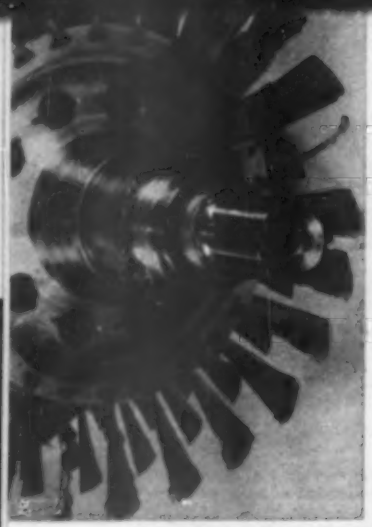
The T53 in the Bell XH-40 has excellent accessibility.

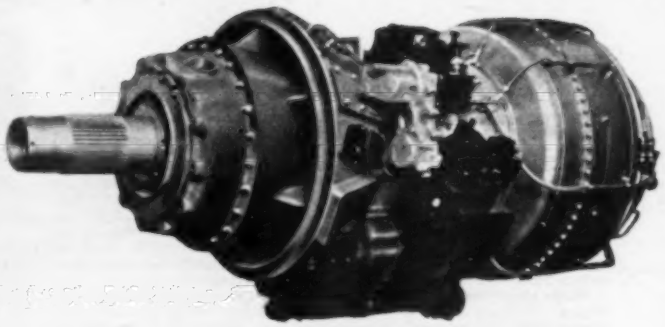
A total of 17 engines were used from the first engine tested in April 1955 to the Model Test engine. Total time at the initiation of the Model Test was in excess of 5,200 hr. The test was run using JP-4 fuel and the engine accumulated a total running time of 181 hours, running perfectly at the completion of the test. Performance deterioration over the test was 1.4 per cent on MIL power, 2.1 on MIL s.f.c., 0.24 on typical cruise power and 0.4 on the corresponding s.f.c.; throttle burst times, oil consumption and similar factors remained generally unchanged. The small deterioration indicates that wear and dirt affect performance roughly independent of engine size.

Curves (on page 83) illustrate data obtained from rotor stand testing and from flight testing in the S-58 and H-21 helicopters. We were pleased with the extremely close correlation of data. Note particularly how quickly and positively each engine automatically changes its power output to maintain a rotor condition set previously by the pilot.

Driving helicopter rotor systems, 700 hours of ground and flight operation have been accumulated. The engine compressor has been tested at simulated altitudes in excess of 35,000ft. The engine has been flight tested at 5,000ft altitude; at airspeeds in excess of 160 m.p.h.; in







Lycoming T53-L-1 (LTC1B-1). Free-turbine engine for helicopters or fixed-wing aircraft (the latter version is depicted). Compressor with five axial stages and one centrifugal stage, annular combustion chamber with 12 vaporizing burners, single-stage compressor turbine and single-stage power turbine. Diameter, 23.25in; overall length, 47.9in; dry weight, 480 lb; mass flow, 10.8 lb/sec; pressure ratio, 5.7 : 1; maximum rating, 825 s.h.p.+102 lb thrust at 21,500 r.p.m. (6,600 output r.p.m.) with s.f.c. of 0.673 lb/hr/e.s.h.p. The fixed-wing version weighs 495 lb. and gives 960 s.h.p.

Left, a T53 compressor after swallowing large foreign objects.

T53 and T58 . . .

chandelles; auto rotation; single and twin engine landings; and rates of climb of 2,000ft/min.

Current programmes include further investigations in an S-58. This will be based at our Flight Test facility at Schenectady, N.Y. We intend to explore in greater detail such characteristics as compressor inlet pressure distribution versus air speed with varying rotor blade dynamics, air restarts, engine control-system behaviour under all possible single- and twin-engine operating conditions, engine temperature characteristics, and other items. Further anti-icing tests will be conducted on Mt. Washington next month and testing will be continued at the Navy's Aeronautical Engine Laboratory in Philadelphia where we have been investigating conditions of −65 to 130 deg F.

THE LYCOMING T53

In contrast to General Electric, Lycoming worked along different lines with the T53, which also marked their entry into the turbine field. Their view can be expressed as: "a clever engine may appeal to the aircraft industry owing to its better brochure figures; but relaxation of the design parameters will permit the evolution of a more durable and easily maintained unit, which might appeal to many automotive fields and be bought in place of reciprocating engines." The company's team at Stratford, led by Dr. Anselm Franz—chief designer of the Junkers gas turbines for the Luftwaffe—won a joint U.S.A.F./Army design competition in July 1952, and had the gas-generator portion of the T53 on test by December 1954.

A paper by Dr. Franz outlines his company's efforts to make the T53 versatile, cheap and reliable. He goes on:

We have emphasized all of the above points in our design, which consists of an axial/centrifugal compressor combination, a reverse-flow annular combustor, a single-stage gas-producer turbine, and a free power turbine. The present T53-L-1 engine is a helicopter unit with front-end power output, and a military rating of 825 h.p.

Regarding the helicopter, we must say that the question "free or coupled turbine" still rings in our ears occasionally. In the light of our experiences it would appear that the predicted advantages of the free turbine in these applications are being realized. Both the HOK and H-40 installations have successfully omitted the usual heavy clutch and also have taken advantage of the opportunity to vary the output speed while maintaining constant power.

Rear-end Drive

With a free-turbine design, a rear-end power output can be more easily accomplished. We felt, however, and our experience seems to prove, that the majority of applications call for a front-drive engine. We therefore developed a design that provides for front-end output, and also would allow the provision of rear power extraction. The reduction gear is coupled with the power turbine by a shaft arranged inside the hollow gas-producer rotor. The critical speed problem of this coupling shaft can be solved with short engine design. Appreciable reduction in engine length was achieved by selecting the centrifugal stage for the high-pressure part of the compressor and by the combustor design which allows the use of the same axial space for diffusion of the compressed air, for combustion, and for expansion through both turbines. It is obvious that a rear-drive can also be easily accomplished with this engine; in fact, power output at both ends can be provided, if required.

In the helicopter field, the low weight and small dimensions of the turbine made it possible to locate the powerplant on top of the fuselage in both the H-40 and the HOK. With this arrangement the ideal payload space below the centre of the rotor became available, and unsurpassable engine accessibility achieved. At the H-40 mock-up review, a complete removal and re-installation of the engine in 15 minutes was demonstrated.

In view of the importance of easy maintenance, our design has provided complete access to all hot parts. The power turbine is supported within the exhaust diffuser, which is a part of the combustor assembly. Since the power turbine is mechanically independent from the gas-producer rotor, the whole power-turbine assembly, including the combustor, can be readily removed without disrupting the remainder. When this assembly is removed, all hot parts, such as combustor liners, fuel vaporizers, turbine wheels and stators, are accessible for inspection or replacement. This operation can be carried out while the engine is installed in an aircraft. We do it frequently in our test work, and we have had occasion to replace complete power-turbine/combustor assemblies, individual turbine wheels, or just a number of blades without removing the engine from the stand. In our design, all buckets and compressor blades are individually replaceable, and the turbine wheels can be replaced without rebalancing.

One of our design goals was a high degree of "ruggedness" which would in turn provide the kind of reliability required by Army-type field operation; 1,000-hr life between overhauls was one of our design criteria. I will highlight our experience with a few examples.

The loading of our main power gears was kept within reasonable limits; as a result, we have never experienced a primary power gear failure. The blades of the five-stage axial compressor are made of 403-type stainless steel. The aerodynamic and mechanical design permitted the selection of a relatively low hardness level to safeguard against impact failures and to avoid stress corrosion cracking. The success of this design in avoiding compressor blade breakage is illustrated (at upper left). This picture shows one of our compressor rotors after having swallowed a chunk of magnesium approximately 3 × 2 × 0.3in; the blades are twisted and bent, but not one is broken. One of the reasons for selecting the centrifugal stage was to avoid the small and delicate blades of the later stages of an axial compressor. Meanwhile, the centrifugal stage has proved to be very rugged. We have never lost a centrifugal compressor during our two thousand hours of operation. Even in the accident mentioned above, the impeller, which is fabricated of 422-type stainless steel, suffered no significant damage.

We have long considered our folded combustion chamber design as a major safety feature, since it provides four layers of steel shielding surrounding the turbine wheels. A turbine blade failure experienced during the development of the larger Lycoming engine (the 1,600 h.p. T55) proved the validity of this concept. By malfunction of the locking device, ten buckets slid out of the fir tree and broke loose. None of them penetrated to the outside. The reverse-flow chamber provides an even radial temperature distribution at the turbine inlet. We have not yet experienced creep of the turbine buckets, although extended tests have been conducted at mean inlet temperatures of 1,700 deg F, which is well above the design value.

Low-cost Blading

In the aerodynamic design of our axial compressor, we provided constant-cross-section blading for each wheel and stator. We were able to use twisted sections of precision-rolled airfoil strip for our compressor stators, reducing the cost of stator vanes from $10 (as machined) to 35 cents each. For 300 hr we have operated an axial wheel with similarly fabricated rotor blades. It is expected that the price per blade can be reduced by this method from $14.50 to $1.50.

Aerodynamic design of the radial impeller has been influenced from the beginning by consideration of producibility. As a result, our impellers are presently cut on a modified standard miller. While this operation requires approximately 65 man-hr, utilization of special tools is expected to reduce this to a few hours. Owing to the small size of our engine, and the favourable temperature distribution, we have been able to use cast turbine buckets and stator vanes. In comparison with forged buckets and vanes, the utilization of cast buckets represents a saving of approximately 80 per cent on these parts.

Last month Lycoming's chief test pilot, Mr. L. L. Middaugh, presented an informative survey of T53 behaviour during actual flight testing. He pointed out that at that time the installed engines had logged 606 hr, of which 295 were in flight (excluding time logged by the Ryan 92 STOL and the Vertol 76 VTOL). The company's own vehicle, a re-engined Kaman HOK, had flown 80.81 hr, and the three prototype Bell H-40s—for which production engine deliveries began this month—had recorded 214.7 hr in the air. The following are extracts from Mr. Middaugh's paper:—

Most of the operational problems which we initially envisioned pertained to the engine control. Essentially this consists of two speed governors, one controlling the gas-producer speed (in other words the power output) while the other controls the power turbine, or helicopter rotor speed. Both governors are resettable in flight so that the pilot can select not only the governing rotor r.p.m. but also the highest power which he may desire during the mission. Only one of the governors has control over the engine at any one time. This is achieved by giving control to that governor which requires the least amount of fuel.

Unlike conventional helicopters, this system eliminates throttle twist-grip co-ordination. The twist grip on the collective pitch lever is mechanically linked to the gas-producer governor and is basically a "power available" control for starting the engine and for establishing the upper limit of power. This primary governor incorporates altitude compensation and acceleration-deceleration limiters, which permit the pilot to make rapid changes in load requirements without endangering the engine. In normal operation, the twist grip control is set to a high power, "full on" position immediately after starting, so that the power-

turbine governor is automatically controlling engine power and rotor r.p.m. throughout a normal mission. The twist grip is used only for unusual manœuvres such as practice autorotations. The power-turbine governor in this control is resettable over a wide range of r.p.m. In the HOK, this manual selection is accomplished by means of a hand crank, which involves removing the pilot's hand from the collective-pitch stick. A more desirable arrangement is found in the Bell H-40 where an electric actuator serves this purpose and is controlled by a "beeper" switch located on the end of the collective pitch stick.

One of the first problems we encountered during the Bell programme was an instability of the power-turbine governor in combination with the rotor and transmission system. This instability resulted in a rapid power oscillation and was intolerable. The controls people had been anticipating this sort of difficulty so that a temporary fix was readily available. Subsequently, a permanent solution has been evolved in the form of a tiny change in the overlap of one of the valves inside the control. Although initial operation in the HOK was perfectly stable, we have tested a considerable number of separate control units with various amounts of overlap on this valve in both the HOK and the H-40. As a result of these tests, we have been able to determine the proper amount of valve overlap for various rotor characteristics.

Fast Acceleration

Acceleration time from flight-idle to full power naturally depends on the flight-idle gas-producer setting. Normally this is established at approximately 15,000 r.p.m. and the YT engines are required to accelerate from flight idle to full power in five seconds. With the HOK we established a flight-idle setting of 13,500 r.p.m. which gave us an acceleration time of 5.5 sec with the initial engine. Another helicopter is presently operating with a setting of around 17,000 r.p.m. so that its acceleration time is of the order of 2.5 to 3 sec.

During the early flights, it was clear that the transient response of the engine rotor system was slow in relation to that of the comparable reciprocating engine in the standard HOKs. Subsequently, incorporation of the droop compensator linkage, which relates r.p.m. to power, apparently improved the transient response because it provided a signal to the governor to increase fuel before rotor r.p.m. actually dropped. We established a standard set of manœuvres on which to base comparisons of transient response; included were jump take-offs, forward flight-hover-forward flight transition, and autorotation with power recovery. These manœuvres have been flown a number of times with various control arrangements and we feel that the transient response of the HOK is now "in the same ball park" as that of a piston engine helicopter.

By and large, the most impressive characteristic of the T53-powered machine is the freedom from continuous power monitoring and trimming. It is literally possible to set the twist grip at military power and then to fly the complete mission without attention to the engine controls until the shut-down after landing. A helicopter pilot who has once flown a helicopter with this type of control is literally "spoiled" with respect to flying the present, conventionally powered machines. Another characteristic of the T53-powered HOK, as compared to its reciprocating counterpart, is the low noise level both in the cockpit and around the helicopter. External noise was found to be ten decibels less at a distance of 200 feet even with rotor-generated sound. Overall frequency in the test helicopter at the pilot's ear level was 98 decibels, or about 20 db lower than the standard HOK-1.

Evaluation of engine performance at altitude has proven to be another very interesting test area. Both the HOK and the H-40 have been flown at altitudes of 15,000ft or slightly above. There were no engine problems encountered in flying the HOK up to this altitude and an excess of power was available even though the helicopter was loaded at its "over-load gross" on take-off. (Most of the HOK flying has been done with a crew of three, plus about 750 lb of instrumentation.) This altitude flying was completed prior to altitude chamber testing so that no prior experience was available to the flight test group. In the meantime, the T53 has been successfully tested in the W.A.D.C. altitude chamber at Wright Field up to 35,000ft, and, during these same tests, starts were demonstrated down to −65 deg F. According to W.A.D.C. personnel, it was not possible to "flame-out" the engine at any altitude below the 35,000ft level.

As you probably know, there had been much concern throughout the industry, over the past several years, about the problem of power matching in a free-turbine multi-engine helicopter installation. We have felt that these problems would be readily solved by the flexibility of the T53 control system. This contention has been vividly proven by the fact that a 10-hour tie-down test in the Vertol 105 (H-21) commenced on November 7, 1957, was completed with less than 12 hours of operating time and the first flight occurred ahead of schedule on November 20. Over 10 flight hours were accrued in the seven days following the first flight. During these tests to date, no power-matching problems have been encountered. Operation was stable and pilot reaction excellent.

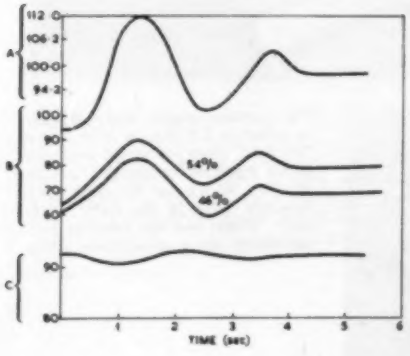
A recent paper by a British engineer working at Lycoming, Mr. K. A. Austin, is entitled "The Industrial and Marine Applications of Lycoming Gas Turbines," and covers the ground with complete frankness. The paper suggests that for industrial success a turbine should cost not more than about $75 per h.p. at 1,000 h.p. or $40 at 500 h.p. Moreover, a life of at least 3,000 hr between major overhauls should be attempted.

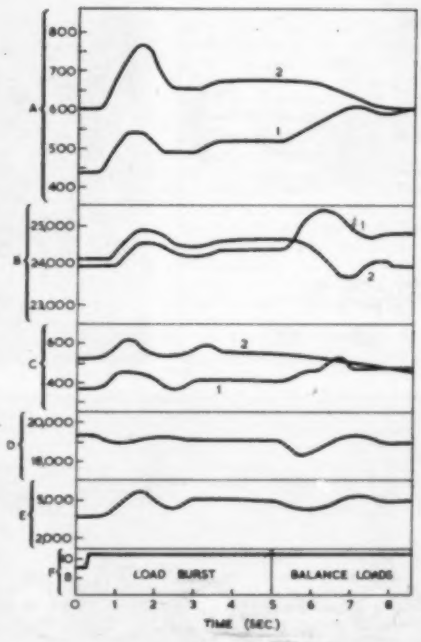
Finally, the following summary of progress was written for us last year by Lycoming, giving an indication of current progress.

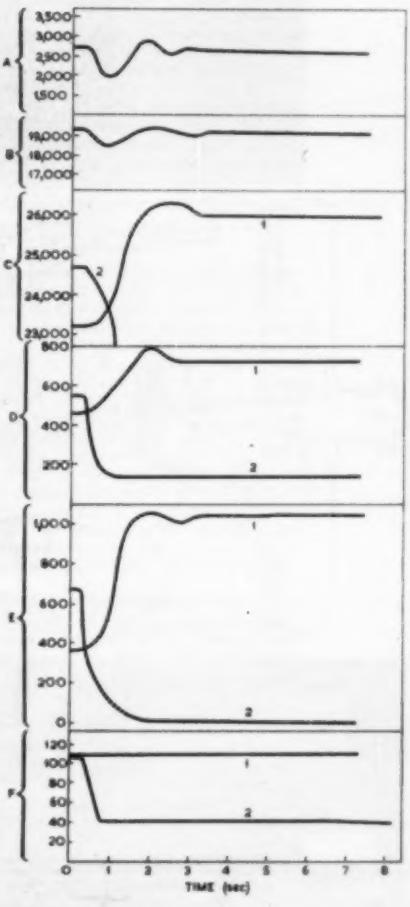
Engine oil consumption has been reduced to less than 1 lb/hr by the use of improved seals at the front compressor bearing and in other areas. Ceramic-coated vaporizer tubes and combustor liners have shown an increase in life of several hundred per cent over uncoated parts. An improved power-turbine nozzle has been incorporated with a resulting decrease in s.f.c. A titanium centrifugal compressor, which reduces engine weight by about 10 lb has been successfully tested. In summary, a total running time of about 3,000 hours has been accumulated. An important series of tests was the anti-icing qualification test made on Mt. Washington. The anti-icing system is unusual because of its automatic, intermittent operation. Air flow from the compressor is passed through a solenoid valve to the top and side inlet struts and through the inlet guide vanes. The system is automatically controlled through the use of an anti-icing detector and interpreter which actuates the solenoid valve. More than 30 hr of testing under icing conditions was completed.

Also, we have completed about 75 hr of running with all-purpose automotive fuel. These tests were of a preliminary nature designed to determine what areas would require concentrated development effort. We found that the engine could be run some 25 to 30 hr without any major effect, although some performance deterioration was experienced. The primary effect of the automotive fuel was to induce a somewhat more rapid corrosion of the fuel vaporizer tube tips due to the lead content of the fuel. In 36 hr the build-up of lead deposits on the turbine nozzle was not sufficient to affect engine performance and there was no apparent effect on the turbine wheels.

T58 curves (see page 81). Left, climb-out by an H-21 helicopter; A, percentage power; B, percentage torque per engine; C, r.p.m.; collective pitch increased at time-zero. Centre below, load burst on S-58 rotor stand: A, torque on engines 1 and 2; B, gas-generator r.p.m.; C, fuel flow; D, power r.p.m.; E, drive torque; F, rotor pitch. Right, S-58 in-flight engine failure: A, drive torque; B, power r.p.m.; C, gas-generator r.p.m.; D, fuel flow; E, torque; F, main throttle (failure was simulated).







Progress Report on the Aerocar

Roadability in Being

Molt Taylor's Aerocar was the subject of renewed interest in the U.S.A. during 1957. The type is fully certificated as an aircraft (above) and as a car (left); five have been built.

A BASIC obstacle to an active light-aircraft movement in this country is the deservedly maligned British weather. Forgetting for the moment the lack of suitable cheap aircraft; and the obstructions caused by official regulations—which it is current fashion to blame for *all* the ills of British private flying—the story of the weekend flight to a destination 100 or 200 miles away, grounding by bad weather, and a delayed return journey, is an all-too-familiar one.

Delays of this kind, and those due to the lack of convenient aerodrome-town transport, are of course not confined to this country. It is in the U.S.A. that most efforts to overcome these problems have been made, and one approach is that of the roadable aircraft, or flying automobile. During the last 13 years, many variations on this theme have been produced.

The most thoroughly proved ground/air vehicle of this type, and one which has triggered much renewed interest in the U.S.A. recently, is the Aerocar two-seat flying automobile produced by M. B. (Molt) Taylor, of Longview, Washington. Five Aerocars have been built; well over 1,000 hours of flight time has been logged; and one of the machines has achieved over 50,000 miles of road operation. The type has been flying for over seven years, and has received full C.A.A. type certification as an aircraft and also certification for road use in the U.S.A.

The principle of operation of the Aerocar is well shown in the photographs. For road use, the car (or front-fuselage) section is driven either by itself or with the remainder of the aircraft folded to form a towed trailer. Assembly of the aircraft prior to flying can be performed by one person in less than ten minutes. The powerplant is a four-cylinder Lycoming O-320 which delivers an effective 135 h.p. to the propeller in flight or 40 h.p. to the wheels when on the road.

Molt Taylor emphasizes that the Aerocar is an automobile which flies rather than aircraft which is roadable. Ensuring complete compatibility for the dual usage was a "terrific problem," but both C.A.A. and road licensing authorities have now given unrestricted approval of the type. The Aerocar's gross weight has recently been increased from 1,950 to 2,100 lb, and future models will include fuel tankage for 40 gallons, giving a cruising range of 450 miles.

Another current development is that of higher-powered models of the Lycoming engine—the 160 h.p. O-340 and the 170 h.p. O-360, which are low-compression units not requiring high-octane fuel. This has proved desirable to cover cases of Aerocars needing refuelling at automobile petrol stations when out of range of airfields.

Driving characteristics of the two-seat Aerocar have been compared to those of a Porsche sports car. Flight characteristics are said to be "sweet," and to compare favourably with those of conventional light aircraft of similar weight and power, and the company is indeed building a prototype "all-flying" version which will not be roadable. By eliminating the automobile components, a four-seater aircraft at the same gross weight will be achieved. This machine will incorporate a tricycle undercarriage, with

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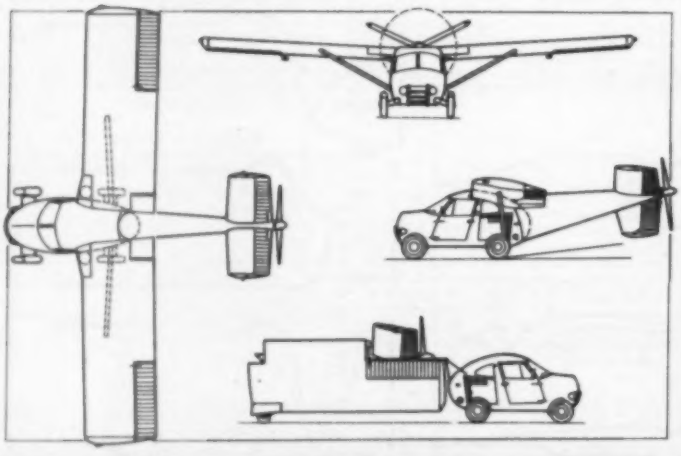

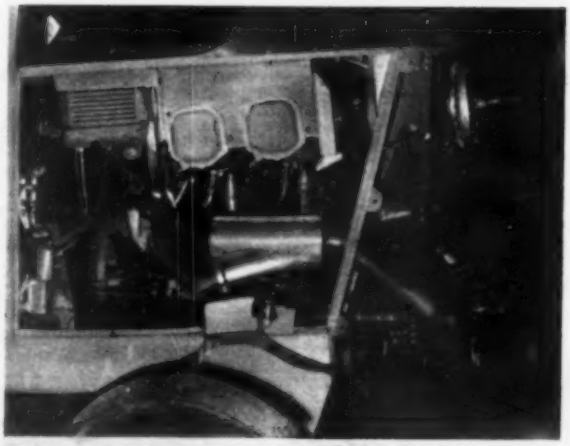

The Lycoming engine (above) delivers an effective 135 h.p. in flight via a "dry fluid" drive and torque converter to the propeller transmission, and an effective 40 h.p. on the road via a four-belt drive to the lower drive-shaft. Wings and rear fuselage convert simply into a towed trailer (left).

Two from Finland: the PIK-11 (above), powered by a Continental A.65; and the H.K.1 (above, right) which uses a Walter Mikron.

ULTRA-LIGHT POT POURRI

By H. BEST-DEVEREUX

APART from the many examples of the better-known ultra-light aircraft at present in use and under construction there is a surprising number of such aeroplanes existing in experimental prototype form or as variations of existing designs.

Probably the most fruitful source of the true "one off" special is the U.S.A., where the members of the Experimental Aircraft Association are able to revel in an inexhaustible supply of cheaply obtained standard parts and dollar engines. Second only to America is France, where at numerous airfields the probing air tourist can find an almost pantagruelic feast of ultra-lights from the most serious to the most fantastic.

The shot in the arm for French light aviation has undoubtedly been the supply of war-surplus light engines, and it requires but little imagination to think what could happen in the United Kingdom if, say, two hundred American flat-four engines were to be available. The British enthusiast must, however, put up with the fact that his economic masters know what is best for sporting flying. He can have his ration of aviation from a TV screen or from trashy films bought for dollars and which on average depicts pilots as "psycho" cases who are so bad that a P.P.L. medical would kill them.

The French are certainly the most prolific producers of ultra-lights this side of the Atlantic, but that is not to say that other countries are lacking. In Finland, for example, one man has made a little amphibian, the Eklund, while another has built the snappy little H.K.1, a veritable miniature fighter of yesteryear's formula, and powered with a Walter Mikron. This little aircraft is the present holder of the straight-line distance record for aircraft under 500 kg, having made an exceptional flight from Madrid to Turku. As shown in the photograph, a large ventral tank was fitted for the long trip.

An opportunity to fly this aircraft was recently accorded to the writer. Having seen it in a corner of the hangar he felt like the small boy and the plum cake—it just had to be nibbled at. Mr. Heinonen, the designer and owner, who helped design the Viihuri military trainer, mentioned that the C. of A. had expired; but there must be something about living in the lesser populated areas, because a five-minute phone call sufficed for authorization to fly.

The cockpit of the H.K.1 is large and comfortable, with a satisfying aerobatic harness and a robust cabin hood sliding fore and aft. Most things in the cockpit are normal except that there are no brake controls, while the trimmer and flap controls are badly placed low down on the port side. A steerable tailwheel is fitted; and this, combined with the lack of brakes, makes for careful taxying—and, equally, makes one decide at an early stage of the approach whether to go round again or into the far hedge.

On the day chosen the cloud-base was low. with a blustery 25-knot wind, so it was not possible to essay any real tests. The take-off requires some care in order to avoid the consequences of a right swing, but once the tail is up the H.K.1 gets on with the job. The gradient of climb seems flat, but largely as expected. Controls are very light, and in gusts there is certainly plenty of work to do. Cruising speed seems to be of the order of 120 m.p.h., while, flaps up, a straight power-off stall comes at about 57 m.p.h., breaking cleanly. Landing is easy, with a slight loss of elevator power as the stick comes back. Once down the aircraft stays down and the steerable tailwheel comes into its own. Altogether the H.K.1 seems to be a delightful modern version of the Comper Swift formula, and according to all reports it is an exciting aerobatic aircraft.

Two from France: the Gatard Statoplan Poussin (centre), Volkswagen-powered; and a Mignet (Continental A.65) owned by M. Croz.

To a simpler set of flying standards and more involved constructional standards, the PIK-11, built by students of a Helsinki technical institute, provides a local comparison with the H.K.1. The PIK has a Continental A.65 and, like its stable-mate, is fitted with a Wittman spring steel undercarriage. The structure is of wood and although the skinning is in the excellent local birch plywood some of the nearly compound curvatures have, in the fullness of time, beaten the efforts of the Finnish enthusiasts to defy the rules of geometry. An opportunity to fly the PIK was foiled by the failure of a main bearing in flight over the centre of Helsinki (where, incidentally, the Hunters of No. 111 Sqn. gave a roof-top display over the centre of the town which did more to raise British prestige than anything before). The PIK pilot pulled off a very creditable forced landing back on the airfield at Malmi and a large *kaput* notice was placed in the cockpit. Certainly in its shape the PIK shows some unconventional thought, but the local boys are very attached to it and have learned a lot from their efforts.

In another direction—at Toulouse, to be exact—there were several aircraft to illustrate the variety of thought among amateur designers. The rally of the Reseau de Sport de l'Air, apart from its spectacle of some sixty amateur aircraft, showed that originality is still a feature of the French aviation scene.

Le Prix des Anciens de St. Yan was awarded at this rally to M. Albert Gatard for his unusual Statoplan Poussin, which is fitted with a Volkswagen engine. Surely one of the smallest aircraft ever built, this little device is developed from the designer's high-wing two-seater Alouette of 32 b.h.p., which was the prototype for testing the theory. The Statoplan has no elevators but is fitted with a large tailplane. Full-span flaps operate both as flaps and ailerons. Back pressure on the stick lowers the flaps,

Left, Jodel D.117 (90 h.p. Continental) fitted with Aeromatic propeller.

Below, LD. 45/4 Planchain seen at 1957 R.S.A. rally.

Above, Claude Rousseau C.P.301B version of the Emeraude two-seater.

Right, Lutetia - powered D.34 Turbulent by Roger Druine has 44 b.h.p.

ULTRA-LIGHT POT POURRI...

thereby increasing the lift, and *vice versa*. Even with a giant of a pilot the performance appeared fairly brisk. Some spectacular *chandelles* and stalled turns were demonstrated.

The venerable Mignet is still a name in French aviation and despite rumour to the contrary certain *Poux du Ciel* still fly, albeit in somewhat modified form. One single-seater version gave a most shattering demonstration at Toulouse by climbing away from take-off at an impossible and sustained angle. What happens following engine failure in such a case was happily not demonstrated. A later two-seat version proved that development of the formula continues. Leaflets distributed show a 90 h.p. Continental-powered version, the H.M. 350, with a streamlined undercarriage, upholstered cabin, dual control-wheels, and semi-cantilever wings which fold. Reports on performance vary; one pilot said that the aircraft was wonderful and absolutely foolproof while another did not like it, complaining that the pivoting front wing transmitted a most undesirable oscillation to the control wheel. Certainly the lack of ailerons presupposes a fight with the ball bank-indicator when turning with rudder alone.

Less spectacular but none the less interesting is the cult of steady and imaginative development of existing designs. The Jodel D.117, produced in series by Lucien Querey, and already submitted to the A.R.B. for C. of A. validation, is illustrated here with an Aeromatic automatic v.p. propeller. This actual aircraft was flown from Deauville to Algiers non-stop solely for the purpose of contradicting a local official who had said in print that French light aircraft did not exist. One has to see the size of the two-metre M. Querey to realize the impact.

The Emeraude, which bids fair to oust the Jodel as the most popular two-seater during the next year or two, has also undergone radical changes in the hands of Claude Rousseau of Dinard. The C.P.301B produced by this busy little workshop has a completely redesigned cabin and hood. Such was the magnitude of this and other changes that the 301B underwent a new flight-test programme at Bretigny, the French Farnborough.

While the slick monoplane certainly holds sway there is always a soft spot for the biplane, particularly as seen in the shape of the LD.45/4 Planchain, which the writer saw aerobatting with tremendous zest. The Planchain is an unusual and virtually unknown version of the Midgy biplanes of 1947.

With the accent on airframe development one hears very little of light-engine progress; the little aero-engine seems to be the Cinderella of the aviation world. On paper the return for a great deal of work seems negligible, but paper theories can so often be wrong—at any rate, one hopes so if light aircraft are to continue. Roger Druine has developed his little Ardem from an air-cooled car engine for use in his Turbulent. Now he has built a Turbulent, the D.34, fitted with a type-tested 44 b.h.p. two-stroke Lutetia for the purposes of full C. of A. tests for his airframe in addition to the restricted C. of A. normally issued to French ultra-lights. Unfortunately the type-tested engine has had a little trouble, and the tests have been delayed.

PROGRESS REPORT ON THE AEROCAR (continued from page 84)

Cessna-type single-leg main gear, and the improved aerodynamics should give a cruising speed of 120 m.p.h.

This prototype, which is due to fly early this year, will retain the folding-wing feature for easy hangarage. The machine is expected to provide much useful information for the future development of a four-seat roadable Aerocar, which is in the planning stage at present. A 250 h.p. Lycoming would provide power.

Among the design features of the Aerocar, the use of a novel French-patented "dry fluid" drive to the propeller is claimed to have eliminated the torsional-resonance problems which have plagued many designs of tail-propeller drive in the past. A noticeable flight advantage of the tail propeller is the absence of any propeller-torque effect.

A recent flight-report on the Aerocar in our U.S. contemporary *Flying* commented on the good spiral stability of the machine. Stall characteristics were said to be excellent. One distinctive feature is that, with the compromise in steering-wheel angular movement for both ground steering and aileron control, more wheel movement is needed for aileron control than in most aircraft.

A major problem facing Molt Taylor at present is that of production—which is, basically, a problem of finance. At Longview, the small but enthusiastic team which he leads have capital and facilities only for development and limited production. Handmade prototypes are necessarily expensive to build, and Taylor is keen to find a manufacturer able to take on large-scale production under licence, in an endeavour to bring the selling price of the Aerocar down to less than $10,000. Negotiations to this end are under way at present with a number of firms, and interest has been expressed in France, Italy and Germany.

In the meantime, members of the company continue to operate its five Aerocars in routine service both as aircraft and as automobiles. Whether or not the Aerocar concept catches on and brings fast and efficient short-range air travel to a lot of people—as on paper and by present experience it can do—depends on large-scale manufacture, which in turn hinges on public demand and an available manufacturer.

Manufacturers may well be impressed by what the Aerocar offers—a fully certificated product ready for production, of simple construction with no blind rivets, no heat-treated parts and no compound-curvature metal components. As for public demand, the present indications are that there is a gap to be filled—not by the more sophisticated, expensive and fast executive aircraft bristling with radio aids, but by the less ambitious yet possibly more useful roadable aircraft. Both will get you through bad weather, but only a vehicle like the Aerocar can be driven home and parked in the garage.

AEROCAR (LYCOMING O-320 ENGINE)

Dimensions and Performance Data

Span, 34ft; wing area, 190 sq ft; wing loading, 11.0 lb/sq ft; length, 21ft (aircraft), 10ft 4in (car), 15ft (trailer); height, 7ft 6in (aircraft and trailer), 5ft 4in (car); empty weight, 1,012 lb (car), 1,400 lb (aircraft); gross flying weight, 2,100 lb.

Cruising speed, over 100 m.p.h.; practical road speed, 55-60 m.p.h. (car only), 45-50 m.p.h. (car with trailer); landing speed, 50 m.p.h.; stalling speed, 46 m.p.h.; approach speed, 70 m.p.h.; climbing speed, 80 m.p.h.; take-off run (loaded), 650ft; landing run (braked), 300ft; cruising range, 450 miles; road range, over 350 miles; road fuel consumption, 15 miles/gal; effective flight power, 135 h.p.; effective road power, 40 h.p.; service ceiling, 12,000ft.

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Pembroke

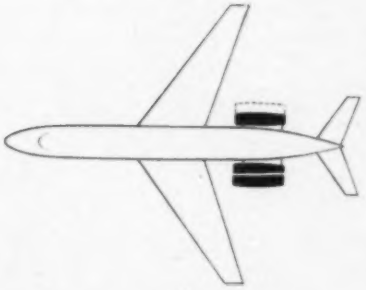
In service with the Air Forces of seven nations, the Pembroke is a versatile general purpose military transport. Passenger seats are quickly removable for conversion to the roles of freight carrying, supply dropping, ambulance, aerial survey or flying classroom.

Straight and Level

A THREE-ENGINED layout for the short-range jet airliner makes operational sense, but it is a trick to engineer. I believe that Avro, Bristol and D.H. have each drafted out 20 or 30 triple-jet schemes. An impression of Avro's favourite, the butterfly tail, was illustrated in last week's issue.

Without entering into a lengthy discussion of the various possible layouts (some of which were shown in *Flight* of September 13 last), I instinctively feel that while you can engineer almost any layout successfully, you are less likely to run into trouble if you can start off by keeping things simple.

I cannot for the life of me think of any serious objection to my favourite scheme, sketched below. Asymmetric



thrust would be negligible, and—most important of all—there would be complete flexibility as to the choice and number of engines. One never knows, some bright firm, British or American, *might* come along with the perfect small transport turbojet, in which event some airlines would be bound to want four. The trunk-line air transport industry has a predilection towards four engines anyway, so should we not keep our minds—and a pod—open?

Not everyone agrees with the view (attributed to a B.E.A. engineer) that the short-range jet should have "fewer than four engines, but more than two." We must export a lot of D.H.121s or Bristol 200s, and might we not therefore avoid tying ourselves down at the start to an inflexible three-engined layout?

A possible objection to my idea might be that turbojet engines should never be too close together. But if we are providing for the burst-engine case we might as well give up designing.

And those who consider my scheme to be inelegant can incorporate a "dummy funnel," putting fuel or golf bags in it if they wish.

● In the Good Old Days of wire and fabric (and they weren't *so* long ago) the industry was sprinkled with critics of other people's aeroplanes who would look at a new prototype and aver, "they'll never get away with that forward view," or, "no . . . the engines are too close in . . . want 'em about three feet further out," or perhaps, "look at that wingtip . . . doesn't look right, does it?"

Today one still finds people who can look at an aeroplane and pronounce on whether or not it "looks right." I remember that a noted American journalist, after studying the S.R.53, expressed the hope that it would be given "either a dorsal fin or increased vertical tail area." The point is this: can we ever, in this era of millions of man-hours, electronic computers and thousands of hours of tunnel time, say that an aeroplane "looks wrong"?

● The de Havilland company have quite a reputation for good undercarriage design (*vide* the Comet, which has a masterpiece in bogies). They have always preferred to design their own undercarriages and I have often wondered whence springs their aptitude for this very specialized branch of engineering. Now I know. Patrick Johnson, writing recently in *Flight*, explained: "It was a defect of Stag Lane—and one which I believe did much to ensure that the makers of the Moth knew all about undercarriage design—that its surface went up and down."

Stag Lane was also, if I remember rightly, very muddy, and the story goes that Sir Geoffrey de Havilland was never quite able to make up his mind "whether to have thin tyres for less resistance or fat ones for better flotation."

● Some airlines just have not the staff to prepare detailed comparisons of all the new aircraft that are being offered to them. But if they don't believe the brochures, why don't they say quite frankly to one manufacturer: Look, we have neither the staff nor the time to evaluate your aircraft on our routes, nor to compare it with your competitor's aeroplane. So will you please prepare a comparison for us, bearing in mind that we intend to show it to your competitors? The airline then makes the same proposal to the competing firms.

I am sure that this practice, if widely adopted, would remove the surrealism from the art of brochuremanship.

● Congratulations to the U.S. Air Force—who at any moment have an average of 1,150 aircraft in the air—on achieving an all-time low in flying accidents with a rate of 14 major incidents per 100,000 flying hours during the first six months of 1957. This is particularly commendable in view of the fearsome, and increasing, complexity of the equipment involved, and of its relative "newness" to those who operate it. For comparison, the worst year ever was 1922, when the old Army Air Corps had a mean of 506 major accidents per 100,000 hr. I wonder why the Air Ministry refuses to publish any figures whatsoever relative to the accident rate in the R.A.F.? It can't be because they are ashamed of their standards.

● The world's air traffic control problem is pretty bad already, but I wonder whether we have yet *fully* appreciated the chaos which may be caused by the new jets—all of them clamouring for critical climb, cruise and descent clearances which they cannot be given?

Of today's situation the *Journal* of the Guild of Air Traffic Control Officers says: ". . . traffic is increasing all the time, more and more delays are being accepted, and A.T.C.O.s are working at mental peaks, some literally on the edge of reason."

I find it difficult to disagree with a remark made by the chief of Vickers' civil aviation development group, Mr. Derek Lambert, at a meeting of Aviation Forum in London last week. Arguing the case for the turboprop, he said: "The airlines need aeroplanes which can be told where to fly and which can fly there without breaking the bank."

This may be difficult to reconcile with the fact that Mr. Lambert's firm is doing a pure jet, the VC-10, for 1963; but jets, like sprinters, stand to benefit from the pacemakers. You do not have to be out in front at the start in order to finish with a place.

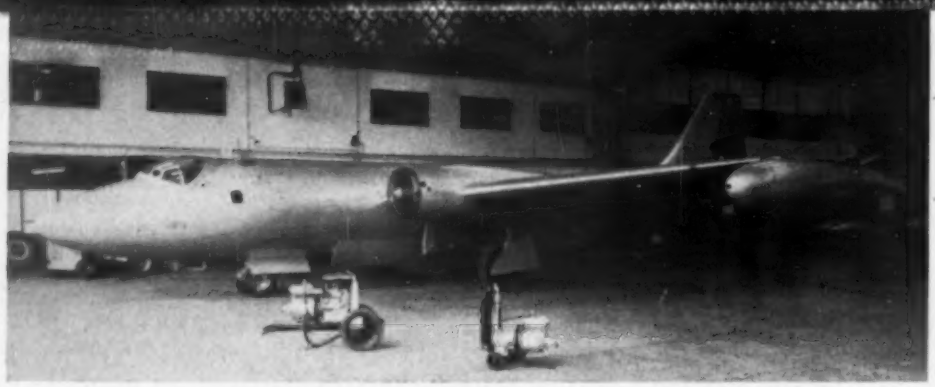
● Here, as the Goons might put it, is a photograph of the obvious answer to the airlines' problem of winter-time traffic troughs. Compress all your airliners in order to bolster the load factors.

The photograph is of a K.L.M. DC-6, and it comes from *Flight's* lively new Dutch contemporary *Aviateh*. Their caption explains (and so aptly, one feels) that the effect was achieved by the Polygoon-Profilti process.

Of course an alternative, and perhaps simpler, solution to the airlines' off-peak traffic problem could be to make photographic enlargements of the traffic.

● According to American geophysicists participating in the International Geophysical Year, the American and European continental land-masses are moving farther apart. So the big jets won't be any use after all. Pity.

ROGER BACON



Two versions of the Hymatic Hydrovane compressor will be supplied with the Canberras (one of which, a T.4, is seen here) ordered by the Indian Air Force. On the left is a 23P100 petrol-driven compressor; the other is the 18E100 electrically powered type.

THE INDUSTRY

English Electric Prizegiving

AT the English Electric Company's annual prizegiving at their aircraft division at Warton, Lancashire, prizes were presented to apprentices by Mr. P. Lord, chief education officer of the Lancashire County Council.

The main presentation, of the Harwood Apprenticeship Award, for the best all-round graduate apprentice who has completed two years of his five-year course, was to D. W. Altham, aged 21.

Summing up the year's activities, Mr. W. C. Dickson, chief personnel and training officer, said that there were now over 100 apprentices at Warton, more than twice the corresponding figure for last year. One apprentice was on the NATO wind-tunnel course at Brussels.

Mr. F. W. Page, English Electric's chief engineer, reassured his audience about the company's future. Manned fighters would continue to be required for various duties in conjunction with missiles of different forms and, because of this, considerable development of the P.1 aircraft was planned. The company's present position was extremely strong, and the current investment programme was intended further to improve this condition.

Research Resistance Welder

A NEW welding machine, Model UAM.150, designed primarily for research work into spot, seam, roll spot or projection welding, has been produced by Sciaky Electric Welding Machines, Ltd., of Slough, Bucks.

In order to make the machine suitable for a wide variety of materials the pressure head is pneumatically controlled and provision made for one, two or three pressure cycles. A frictionless roller-bearing diaphragm head is fitted. The electronic Sciaky control panel allows for accurate timing control from ½ cycle upwards; phase-shift stepless heat control; slope control; and pre-heat and/or post-heat. Three Sciaky Dekatron timers, plus motor control, give an almost infinite combination of machine settings.

The control circuit and time-control equipment are housed in a separate cabinet to eliminate any inaccuracies caused by vibration or interaction from the welding transformer fringing fluxes.

For Cable Testing

TESTING of cable-forms and cable looms is, even nowadays, often an extremely laborious process. To provide a degree of automation in this sphere an automatic cable-form test set is being produced by Gate Electronics, Ltd., Tudor Grove, London, E.9.

Their ATC-25 test set is operable either automatically or manually, selection being made by a simple change-over switch. In automatic use the machine operates continuously after being started by a push button on the front of the test bench; it will stop only on the discovery of a fault, or at the end of a test sequence. The test consists of a comparison of continuity between the adaptor boxes and a master circuit plugged into the front panel. Any discrepancy causes the machine to stop, the reason for stoppage being indicated by lamps on the front panel. After the fault has been noted the test can be continued by again operating the start button.

Each wire is tested with regard to all other wires, the time taken for a test being about 16 seconds for a simple 25-way cable-form. When a smaller number of wires than 25 is involved, an automatic "homing" switch can be set for 6, 12, 18 or 25 ways. The machine will then test up to the number selected and immediately "home" to its normal reset position.

The comparator effect of the machine can also be used to determine the wiring of an unknown cable form since, by running without a master circuit in position the machine will seek, stop at, and indicate (as a connection fault) all the connections made in the unknown form.

Selection of the manual position of the change-over switch will cause the machine to stop not only at faults but also at correct connections. A cable-form can thus be tested one wire at a time when investigating intermittent conditions. Test voltage applied on both auto and manual is 6V, and the current does not exceed 70mA.

The standard equipment includes 25-way "Unitor" sockets into which adaptor boxes for any type of termination may be plugged. For testing cable looms spring connections are provided on the wiring board and are connected to the test equipment. The "master" cable-forms used can be actual cables or special "programme" plugs.

Direct-reading Tachometer

ONE of the newer products of Racal Engineering, Ltd., is their MA.38 tachometer. Used in conjunction with Racal digital frequency meters, types SA.20 or SA.21, it may be employed for direct reading of shaft-speed measurements, in the range 100/20,000 r.p.m.

Racal MA.38 tachometer.

The MA.38 consists of a rotor with 60 teeth rotating in a magnetic field, so that an output of 60 pulses is obtained for each complete revolution. This output is fed to the frequency meter which (if so required) can sample the input for one second, in order to give a direct indication of the shaft speed in r.p.m. Other types of measurement may be made with this tachometer by transforming linear or other movement to rotary action, and it may also be used in conjunction with other digital frequency meters using a one-second time base.

The headquarters of Racal, Ltd., are at Western Road, Bracknell, Berks.

IN BRIEF

The London office of Permali, Ltd.—and of the associated companies of Hordern Richmond, Ltd., and Hydulignum-Jabroc (Tools), Ltd.—is now at 39, Victoria Street, London, S.W.1. The telephone number, ABBey 6494, remains unchanged.

* * *

The John Bull Rubber Group has acquired part of the John Richardson factory, at Evington Valley Road, Leicester. The premises will be used primarily to increase accommodation for the C.P. Engineering Co., Ltd., a subsidiary of the group.

* * *

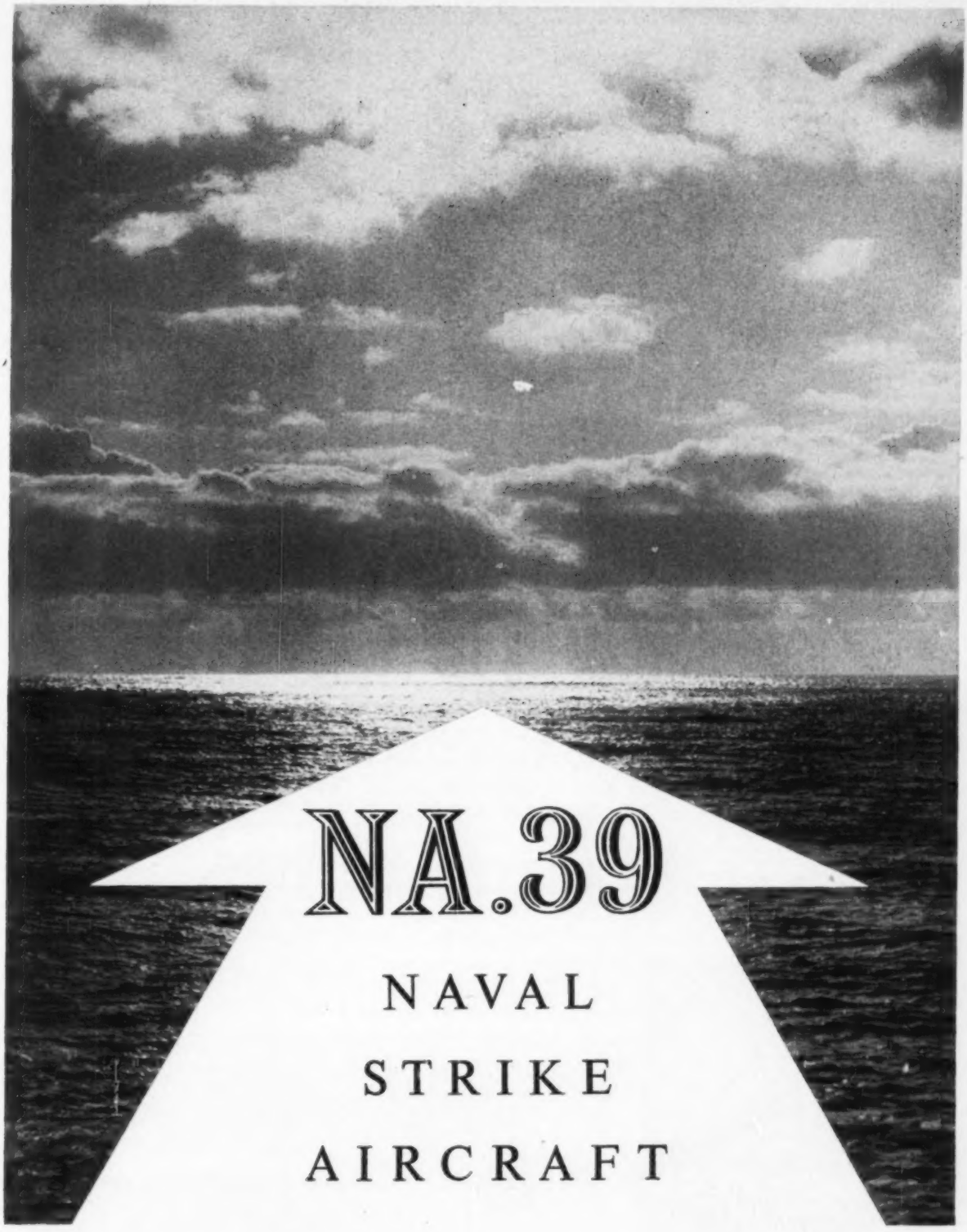
After three months in Canada studying trade conditions and prospects, Mr. K. J. Palmer of Birlec, Ltd., is back in England. Mr. Palmer, who is the company's London Office manager, has established an office in Toronto and it is possible that the company may not only sell its furnaces in Canada but may also manufacture them there.

* * *

Thin-wall PTFE tubing is one of the products of the newly formed Polypenco Co., Ltd., Welwyn Garden City, Herts, subsidiary of the Polymer Corporation of Reading, Pa, U.S.A. The tubing is available with internal diameters ranging from ¼in to 1in, with wall thicknesses of from .030in to .050in, and in ten colours. The makers state that the dielectric properties of the tubing make it particularly suitable for wire bundling and sleeving insulation.

* * *

Mr. J. A. C. Williams, M.Sc., A.M.I.Mech.E., A.F.R.Ae.S., A.B.Ps.S., has been appointed principal of the College of Aeronautical and Automobile Engineering, Chelsea. Previously head of the engineering section of the National Coal Board's industrial training branch, Mr. Williams has been concerned with technological education since 1939. In 1939 he was a lecturer at the de Havilland Technical School, and during the war was with the initial design team for the D.H. Mosquito. He also worked with the Airscrew Co. and Jicwood, Ltd. In 1954, Mr. Williams was made a Research Fellow at the College of Aeronautics, Cranfield.



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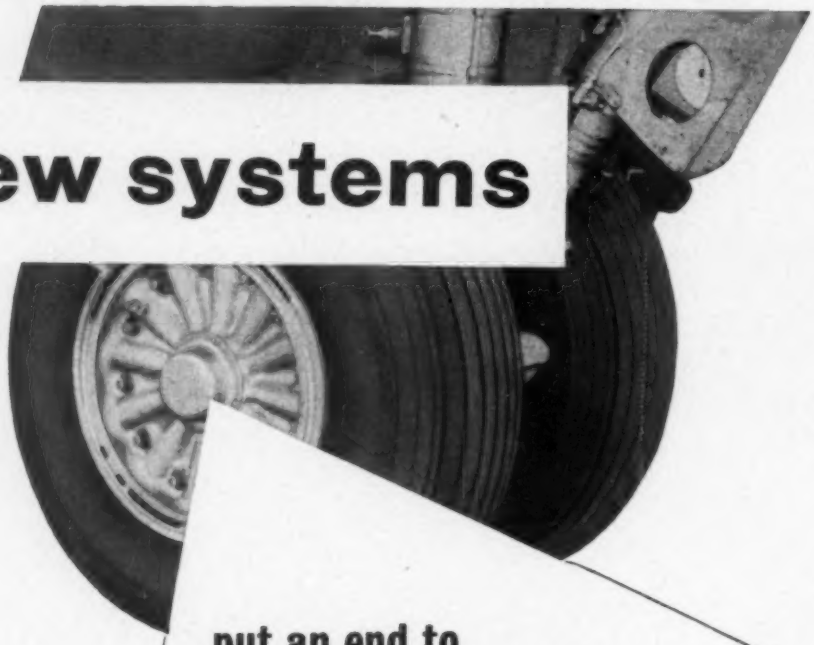

2 new systems

put an end to the dangers of landing skids

Goodyear offer the choice between two new systems which prevent wheel locking and excessive tyre wear, and guard against dangerous tyre bursts.

Skid Warning System Warns the pilot the moment the rotation of any tyre begins to drop at an abnormal rate. The pulsating of a button mounted on the brake pedal tells him to ease up on his brake pressure. Easily fitted to existing aircraft without major modifications.

Anti-Skid System Automatically senses any impending skid, releases brake pressure instantly and re-applies it immediately the danger is past. Positively protects against wheel locking and relieves the pilot from the necessity of under-braking to prevent skidding.

For both systems there are the alternatives of electrical or electro-mechanical detection. Goodyear engineers will gladly provide further information.

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Tyres · Wheels · Brakes & Associated Equipment

THE GOODYEAR TYRE & RUBBER COMPANY (G.B.) LTD., AVIATION DIVISION, WOLVERHAMPTON

Still going strong with many clubs and groups is the veteran Tiger Moth. This photograph, taken by Peter Shephard of the Rochester Flying Club, shows one of the club's Tigers flown by instructor Vic Arnold. Two Tigers and one Autocrat make up the fleet of the club which, with S/L. F. Holt as chief flying instructor, is operated by Short Bros. and Harland.

CLUB AND GLIDING NEWS

WITH a total of seven R.A.F. flying clubs in operation at present, plans have been made for the formation of an R.A.F. Flying Club Association. This would follow the example of the R.A.F.G.S.A., which caters for gliding and soaring enthusiasts in the Service. The first two R.A.F. clubs to be formed were at Middle Wallop and Thorney Island. Following various difficulties these clubs were forced to disband, but not before their example had been followed by No. 47 Squadron Flying Club at Abingdon, where S/L. D. P. Boulnois (now at Air Ministry) was squadron C.O. This club, formed in December 1954, now has 30 members, and had logged 700 hours' flying by the end of last November. In 1956 No. 83 Squadron at Syerston and the R.A.F. station at Upwood formed flying clubs, which have since flown a joint total of a further 700 hours. Membership of the 83 Squadron club now stands at 80, and the club has established such a sound financial foundation that members' subscriptions have been abolished.

The remaining four clubs, formed last year, are at Watton, Manby, Boscombe Down and Little Rissington. Most of the R.A.F. clubs operate Tiger Moths or Austers, which are normally purchased with the aid of a loan from the Kemsley Flying Trust. The Abingdon club, which repayed 80 per cent of its loan within eight months, achieved 22 first solos and four P.P.L.s during its first year of operation. Its operations include parachuting and glider-towing in addition to flying instruction.

ANNUAL dinner of the Association of British Aero Clubs will again be held at the Waldorf Hotel, London, this year. Tickets for the dinner, which is at 7 for 7.30 p.m. on Friday, February 7, cost 30s and are obtainable from member-clubs of the Association. The tradition that this function is an all-male affair continues.

A NEW Italian two-seater sailplane, the C.V.V.8 Bonaventura, has been designed by E. Preti and built at the Polytechnic School of Milan University. Construction is all-wood with ply and fabric covering, and the laminar wing sections are NACA 65618 (root) and NACA 63212 (tip). First flight of the new sailplane, which is estimated to have a maximum gliding ratio of 1 : 40, was made just before the end of 1957 at Venegono, the Aeronautica Macchi field near Varese, by Commandant Mantelli. The Bonaventura is to be delivered to the Italian gliding school at Rieti. Dimensions include: span, 62ft 3in; length, 26ft; wing area, 220 sq ft; aspect ratio, 18; gross weight, 1,058 lb.

ONCE again a question concerning gliding, raised in the House of Commons, has produced a long Ministerial answer combining the customary shoal of platitudes with an incredibly small amount of information. The question, raised by Sir Roger Conant on December 19, referred mainly to gliding in the R.A.F. and the A.T.C. If the R.A.F. was to obtain recruits through gliding, he said, the Service must do two things: it must interest the potential A.T.C. recruit in the sport of gliding, and it must be able to tell him, once interested, that he would obtain better gliding facilities if he joined the R.A.F. than if he did not. At present A.T.C. gliding training went no further than the "B" Certificate; better results would be obtained if soaring experience were included. While it might not be practicable to extend all A.T.C. training up to "C" standard, the use of T.42s for aero-towed launches, rather than winch-launched T.21 Sedberghs, should be considered.

Sir Roger concluded by asking for the latest information on negotiations for Lasham, where the Surrey Gliding Club and other clubs had suffered insecurity of tenure for many years.

In his reply, Mr. Charles Orr-Ewing, Under-secretary of State for Air, said that gliding certainly was a delightful sport. Anything which he could do to make it more widely available he would most certainly do—provided that it did not lead us into economic difficulties. Other points from Mr. Orr-Ewing's speech included the following:—

"We feel that, while gliding is a fine sport and one very especially appropriate in the R.A.F., it should continue to be regarded mainly as a sport and that the mainspring of its advance should therefore be the private initiative of individual enthusiasts. We do not feel that we should be justified in extending the financial help that we already give. . . .

"The amount of gliding which we do in the A.T.C. is not insignificant. We have one full-time gliding school and 20 weekend flying schools, and in the six months up to September 1957 no less than 46,000 launches have taken place in the A.T.C. . . .

"The Royal Air Force no longer wants the (Lasham) airfield and there is no other Government need for the land apart from a minor Ministry of Supply interest which need not at this stage affect the main question of the airfield's future. We therefore intend to dispose of the land. Naturally our first thought would be to offer it to the former owner.

"Before we can get down to this, we must take account of the views of the local planning authority on the future use of the land. We have had preliminary discussions with the authority and have now applied formally for a planning determination. When this is received the district valuer, who has been instructed on our behalf, will open negotiations with the former owner. That is the order in which these things must work. . . .

"I can give an assurance that I and my hon. friend the Joint Parliamentary Secretary to the Ministry of Transport and Civil Aviation, with whom I am in constant touch on this matter—and who, in turn, is keeping the British Gliding Association fully informed—will continue to keep a close personal watch on the problem. We are glad that we have been able to help the clubs at Lasham in the past, and we are fully mindful of their present and future interests. . . ."

Below, the new Italian two-seat sailplane built at Milan and known as the C.V.V.8 Bonaventura (see news item on this page). Right, two keen young members of the W.J.A.C., Carol Coker and Sandra Ansley, who have been receiving air-experience flights at Fair Oaks Aero Club in return for catering help at weekends.

CORRESPONDENCE

The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.

Flying on One Eye

IN reply to the comment by Mr. Conry (December 13) on the question of the one-eyed pilot, and the many words from Cyclops 2 which fill over three-quarters of a column (January 3) on the same subject, it should be pointed out that nobody has disputed the fact that a number of one-eyed pilots are able to pilot aeroplanes. Instances of one-eyed pilots who fly well illustrate an admirable triumph over a disadvantage—they do *not* prove that the disadvantage does not exist, which was the point under discussion.

Mr. Conry remains curiously silent about his Association. May I now address a question to the Publicity Committee of the Royal Aero Club, who surely know about these things. What *is* the British Aeroplane Owners and Pilots Association, apart from a line beneath Mr. Conry's signature in letters to *Flight*?

London, S.W.8. K. TUDOR.

What the Stars Foretell

THE perspicacious prediction by Miss Crystal Ball, in her "Old Bore's Almanack" (Correspondence, January 3) that in September 1958 a new ejector seat for the Fleet Air Arm will be announced, capable of astonishing performance, may prove remarkably accurate.

Security considerations are probably preventing informed people from declaring that such a seat is here now. However, giving time for operational requirements to be formulated, specifications prepared and contracts signed, September 1958 seems to be a pretty good guess of the announcement date.

What intrigues me more is whether your correspondent's other predictions will also materialize. Certainly my diary confirms that Christmas Day falls on a Thursday. "Old Bore's Almanack" will be well worth watching.

Amersham, Bucks. EXPECTANT.

Society of Aircraft Historians?

THE proposal by "Beltane" (December 6) to form a society for those interested in the history of aeronautics will surely have support from all over the country.

If your correspondent will agree to receive names and addresses of all historians, amateur or professional, who would help foster this idea I am sure he will be surprised at the amount of response he will get. I, personally, know of three people who will give every assistance and who look forward to the formation of such a society.

Expense need be only negligible. And, perhaps, when the society is a going concern *Flight* would allow us a little space to report our progress and activities.

It is to be hoped that "Beltane" will agree to my suggestion and let us have his name and address so that all who are interested may write and help him form this much-needed society.

Hounslow, Middx. H. F. COWLEY.

Restrictions on the Private Pilot

YOUR recent correspondence on the restriction of private flying has proved interesting, due to the various opinions put forward by pilots and air-traffic controllers as to who is to blame for the state of affairs. The airline pilot's opinion (minority, of course) is that the private flyer is a "deadbeat" and the cause of it all! Yet, where would the former be today without the sympathetic attitude and the guiding hand of his instructors?

Does the carping airline pilot stop to think what a dangerous business this single-engine flying can be under many circumstances? One can easily criticize and pass advice when one is sitting between four big engines with duplicated A.D.F., I.L.S., hot and cold running fixes and stewardesses, to say nothing of a crew to share the ulcers of flying close to the limit! How would the airline pilot like to fly in a Proctor, at night, in 2,000 yards' visibility (fog), on one V.H.F. set, to be told that he could not have radar assistance to his base because he only held a night rating and not the full instrument rating! Yet this happened, only a month ago.

Given such treatment the airline pilot would down tools and take up farming. But the private flyer has to press on or give up. Those who do give up do so principally because of the attitude of the real enemy, the M.T.C.A. The air-traffic controller says everyone should have radio. An ideal proposition. But has he ever stopped to consider the difficulties involved? Many current V.H.F. sets with a reliable performance carry an extreme weight penalty for a light aircraft, to say nothing of the cost of purchasing, the fees, and "bull" of the A.R.B., not forgetting that the Postmaster General suddenly puts a demand on the pilot for £1 per year for doing absolutely nothing!

Then, of course, there is that useless bit of paper called an R/T. licence. If you live at Wick (Scotland) you have to take two days off from work, travel to London (about £8 return), sit in a little box in the madhouse at Berkeley Square and go through a parrot-fashion rigmarole which will in no way help you to carry out a competent R/T. discourse in an aeroplane which is bumping all over the sky, while you are trying to find the crystal that fell on the floor when you tried to crystal up!

Some two years ago the writer put up the suggestion that R/T. licence tests should be carried out at M.T.C.A. aerodromes and conducted by chief air-traffic controllers under actual flight conditions—but no! Far too common-sense? Even with his radio, and licence, the private pilot will find that there is no UNICOM as in the United States, and no standardization or coherency of radio channels—except 121.5, which he will be terrified to use until he is down on the water!

The air-traffic controller, Mr. Wilde, mentions in *Flight* (December 20) that "private flying in America is thriving partly because aircraft owners are radio-conscious. . . ." I would like to advise him that most of America's private flying is done from non-radio airfields; and, further, if Mr. Wilde would pay a visit to the U.S.A. he would find that their A.T.C. operators not only give "light-gun" signals, but give them very clearly and efficiently. However, such is the plethora of radio communication that the Americans have worked out a signalling system so that lights from the tower are acknowledged—it is very simple, and it works; the probable reason why the M.T.C.A. have not adopted it here.

It is our opinion that the unhappy state of affairs of private flying in this country will not be any happier until the desk-flyers at B.S. House are moved to the operation of desks, and their places taken by pilots used to the operation of aeroplanes.

E. Grinstead, Sussex. M. J. CONRY,
Hon. Sec., British Aeroplane Owners and Pilots Association.

German World War I Rarities

ON reading *Thrilling Flights*, edited by Capt. W. E. Johns, and *Pilot's Summer*, by Frank D. Tredrey, I found, in each instance, a reference to an unusual type of 1914-18 German aircraft. Here is a description of both types; I would be grateful if the experts could identify them.

In the first instance (*Thrilling Flights*), Capt. L. W. B. Rees (who later won the Victoria Cross), flying an old Vickers fighter, with F/Sgt. J. M. Hargreaves armed with a stripped Lewis gun, spotted and fought *a machine with two fuselages with tractor screws, and a nacelle with a propeller behind.*

In the second instance (*Pilot's Summer*) Mr. Tredrey describes the contents of a German pilot's photograph album. Of particular interest was *a small twin-engined three-seater with three rudders and machine guns on swivels pointing in all directions.*

Incidentally, I must congratulate John Barron (December 13) on his suggestion for an aviation book club (publishers please note). In my humble opinion this is a winner. Have other readers anything to add to the suggestion?

Birmingham, 14. MAURICE AUSTIN.

Pardon our Accent

I HOPE those who "bouffed" the opera in line 28, 1st column, page 863 of *Flight* of December 6 have not suffered from distended stomach.

There is a world of difference between an *opera bouffe* which comes from the words *opera bouffon* (comic opera) and an *opéra bouffé*, the word *bouffé* meaning "eaten" in slang French.

Please treat this letter in the *opera bouffe* spirit in which it is sent.

Paris, XVIe. H. R. GILLMAN.

A Publisher Looks Ahead

YOUR Reviewer "A. C. B." ends his recent notice of Werner Buedeler's *Operation Vanguard*: "How useful it would be if an enterprising publisher were to get a similar book from Russia about how the programme there was brought to fruition."

In the light of this comment it may be of interest to your readers to know that we attempted to obtain such a book from Russia long before the Sputniks were first launched. In fact, the only books and information forthcoming from the Soviet authorities offered no original material or indication of forthcoming events for which we were looking and did not warrant our publication in this country.

London, E.C.1. HAROLD K. STARKE,
Director, Burke Publishing Co., Ltd.

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Planning and Installation of Military and Civil Radar Systems

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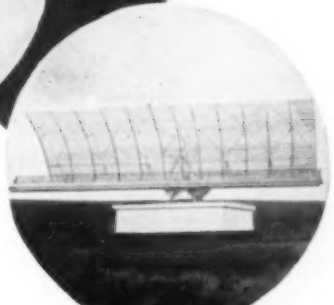
Storm Warning Radar can now be recognised as an important element of an Airport Radar system.
The SNW 51 provides an accurate and up-to-the-moment picture of the movement of storm centres and areas of precipitation over ranges up to 200 n. miles. Remote displays, static or mobile versions are available.



TYPE S264

TYPE S 264 AIRFIELD CONTROL RADAR

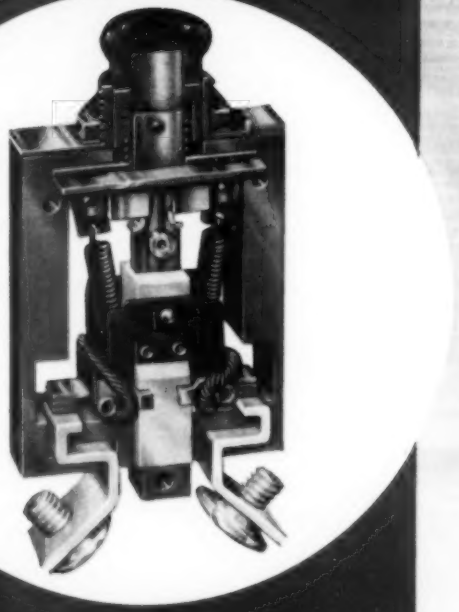
has been specifically designed for civil air traffic control and is not a modified military type. It operates at full efficiency in all weathers because the wavelength is long enough to penetrate cloud. Ground clutter which obscures aircraft response is removed by means of an extremely effective M.T.I., thus rendering identification procedure unnecessary. The equipment is instantly operational at its rated performance because it is crystal controlled and needs no adjustment after switching on. The S 264 is suitable for monitoring aircraft on airways at the approach to the control zone, controlling them in the stacks and feeding them on to ILS or PAR, providing limited P.P.I. controlled approach to runways and taking control of outbound aircraft as soon as they are airborne.

MARCONI

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX, ENGLAND

R3

This aircraft circuit breaker gives independent, automatic, overload tripping for complete circuit and component protection



This robust, Push to operate Pull to release, circuit breaker will trip automatically in all overload conditions. Even if the button is held in, it will trip internally, completely independent of the mechanical operation. It is available in a range of ratings from 5 to 50 amperes and all conditions of overload up to 6000 amperes will effect tripping—without damage to the breaker or the circuits and components which it protects.
Mechanically, the Type 700 circuit breaker is small, strong and of superior design. The thermal latches are independent of the mechanical latches used for the normal switching operation. Wiping-action contacts maintain low resistance and are self cleaning.
The equipment is offered with either shrouded or unshrouded terminals.

For qualified engineers interested in working on advanced equipment of the type illustrated, the opportunities at Plessey are outstanding. Write to the Personnel Officer for information.

Plessey

Type 700 trip-free circuit breaker

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A76

SERVICE AVIATION

Royal Air Force and Naval Flying News

A Lincoln of No. 10(M.R.) Sqn., R.A.A.F., dropping rescue equipment—a stick of containers—to a "ditched" crew during A.S.R. exercises carried out recently off the Australian north-east coast near Townsville, Queensland.

New R.A.F. Aide-de-Camp

APPOINTED an Aide-de-Camp to the Queen with effect from January 7 in succession to A. Cdre. P. H. Dunn, G/C. H. E. Bufton is at present Senior R.A.F. Officer Persian Gulf, with headquarters at Bahrein. He had a distinguished wartime career, being awarded the A.F.C. in 1942 and in 1943 and 1944—while in command of No. 109 Sqn.—successively winning the D.F.C. and the D.S.O. He was also mentioned in dispatches in 1943 and 1946. Before assuming his present post he took a refresher course on Vampires at C.F.E.

Antarctic Congratulations

A MESSAGE of congratulations was sent by Marshal of the Royal Air Force Sir Dermot Boyle, Chief of the Air Staff, to S/L. J. Lewis following his achievement of the first flight by a single-engined aircraft across the Antarctic continent (see picture and caption on p. 92). In his signal to S/L. Lewis, who is C.O. of the R.A.F. detachment with the Trans-antarctic Expedition, the C.A.S. said: "The Air Council and I have read with great admiration of your historic flight over the South Pole from South Ice to Scott Base. We send to you and your colleagues our warmest congratulations and good wishes."

F.A.A. Promotion

AMONG senior promotions recently announced by Admiralty is that of Capt. (Acting Rear Admiral) D. R. F. Cambell, who became rear admiral with effect from January 7.

Rear Admiral Cambell, who is Flag Officer Flying Training, was responsible (in conjunction with a civilian officer) for the conception of the angled-deck system which is now incorporated in all British and American operational aircraft carriers.

Prior to his present appointment Rear Admiral Cambell was Director of Naval Air Warfare at Admiralty. At the outbreak of war he commanded No. 803 Sqn. in H.M.S. *Ark Royal* (being awarded the D.S.C. in 1940 for his general good services with the F.A.A.) and during 1940 and 1941 he was a test pilot at Boscombe Down. One of his later wartime appointments was Cdr. (Flying) in H.M.S. *Argus*, and in 1947 he became Cdr. (Air) in H.M.S. *Glory*.

Scottish Gliding School

AT R.A.F. Turnhouse tomorrow (January 18) A.V-M. P. D. Cracroft, who in addition to being A.O.C. No. 18 Group and Senior R.A.F. Scotland is A.O.C. Cadets, is to open No. 661 Gliding School for A.T.C. cadets—which will be the only one of its kind in Scotland as two previous gliding centres, at Edzell and Dumfries, ceased to exist when those R.A.F. stations were closed last year.

A.V-M. Cracroft will fly on the first launch and afterwards an aerobatic display is to be given by S/L. J. Scott Cooper, A.T.C. district gliding officer, in a Prefect.

Air Ministry is exploring the possibility of a further gliding school—perhaps at Dyce—for cadets in north-east Scotland.

Air Materiel Command

FORMERLY Chief of Communications at R.C.A.F. headquarters in Ottawa, A. Cdre. C. L. Annis took over as A.O.C. Air Materiel Command at Rockcliffe on January 6 with the rank of air vice-marshal. During the war he was captain of the first aircraft to attack a U-boat in North American waters and he later served with the R.C.A.F. No. 6 Bomber Group in U.K.

Air Marshal C. E. Chilton, A.O.C. Malta, inspecting a ceremonial parade at R.A.F. Idris on January 2 when he made his first official visit to Libya since assuming his Mediterranean appointment last November. Accompanying him is the station commander at Idris, W/C. W. Stapleton.

R.A.F. Promotions

NAMES of senior officers increased in rank by R.A.F. half-yearly promotions were given last week. A further list, under branches (and with decorations omitted for reasons of space), is published below:

G.D. Branch

W/C. to G/C.: R. F. H. Clerke, W. A. Toyne, D. D. Haig, G. B. Walford, J. D. Warne, T. C. Musgrave, W. A. L. Davis, F. R. Bird, J. H. L. Blount, A. D. Frank, P. C. Fletcher, L. W. G. Gill, T. L. Bingham-Hall, A. G. Wilson, W. T. Brooks, G. H. Goodman, H. A. S. Disney, A. C. Deere, T. R. Burne, J. Wallace, E. W. Tacon, A. H. C. Boxer, E. D. Crew, C. S. G. Stanbury.

S/L. to W/C.: J. Harris, H. Mansell, J. C. Forbes, F. W. Davison, A. Brown, J. Campbell, L. G. Press, A. R. Wilson, J. T. Lawrence, R. G. B. Summers, S. McCreith, J. Rayson, J. G. Roberts, A. D. Boyle, P. D. J. Wood, G. A. Martin, L. G. Holmes, J. G. Bishop, M. D. Wylie, R. D. Doleman, J. C. Cogill, R. A. N. McCready, E. Cook, J. E. Tipton, I. MacDonald, L. L. Harland, J. R. Forsythe, S. C. Dunmore, R. S. Sanders, G. Hampton, M. J. Beetham, E. W. Merriman, G. Sproates, A. J. Houston, N. J. Carver, D. M. Finn, W. Harbison, B. W. Parsons, L. B. Foskett, D. C. Lowe, H. E. Walmsley, N. Poole, W. E. Martin, L. G. Martin, F. S. Hazlewood, S. R. Hodge, J. R. Gibbons, K. F. W. Tapper, N. E. Hoad, G. H. Melville-Jackson, J. M. Daniel, E. H. Turner, G. C. Brunner, A. L. Hamilton, W. A. Cormack.

F/L. to S/L.: J. W. Willis-Richards, H. W. Taylor, J. W. Kerr, W. J. C. Jones, A. Denovan, L. Davies, W. J. Heeley, L. J. O. Prudence, T. C. Waugh, G. G. Robinson, G. H. Quick, R. T. Howard, H. J. West, H. J. Irving, G. P. B. Bailey, K. M. Wickson, J. G. Brodie, A. J. Hayter, A. G. Corfe, J. C. Downs, E. A. Devillez, J. A. Paton, K. Fanthorpe, R. A. Parfitt, P. A. Dace, E. L. Nieass, J. V. E. P. Carter, G. G. Beaugeard, G. F. Webb, R. Goring-Morris, D. R. Barnicoat, A. Twigg, C. S. MacD. Bartlett, L. J. Cook, R. R. Edwards, A. E. F. Buick, R. L. Kerr, J. W. Morrice, M. F. Laing, E. Laraway, R. N. Bates, D. G. Bleach, C. S. MacDonald, J. L. Fellowes, R. S. Peters, R. A. Pendry, J. H. Granville-White, J. M. Crowley, J. MacG. Robertson, L. L. Tuke, F. M. N. Taplin, H. C. Richford, D. B. Robinson, P. D. Wright, P. T. Hall, C. H. Walker, E. F. Hemming, D. Wright, M. G. Waudby, W. J. Herrington, M. H. Miller, J. C. Atkinson, R. MacA. Furze, K. J. L. Baker, W. G. Holmes, J. P. Gledhill, W. G. Hester, A. R. Satow, D. Parratt, P. J. Bardon, E. N. Barrington-Reinganum, C. J. S. Wood, P. W. Shaw, T. E. M. Dunne, H. A. Harvey, C. A. E. Simons, M. O. Bell, I. A. N. Worby, J. R. Rogers, J. F. W. Pembridge, J. Gingell, K. J. Aedy, A. L. Tauwhare, D. L. Stoten, J. W. Beale, A. E. M. Barton, B. J. Scowen, B. Brownlow, G. P. Kingston, F. R. Lockyer, L. A. J. Patey, W. S. Akeroyd, G. D. Durbridge-Freeman, J. Tinsley, T. A. Newman,

SERVICE AVIATION . . .

H. J. Meddings, R. G. Grocott, D. Newell, V. A. Stapley, J. M. Fryer.

F/L. to S/L., Branch List: V. Vesely.

Technical Branch

W/C. to G/C.: B. Samson, R. E. Beeny, J. W. White, S. F. Bonser, J. S. Rowlands, E. V. Stokes, J. H. Hunter-Tod.

S/L. to W/C.: M. L. L. Bathe, F. E. Barnes, G. V. Cowmeadow, J. T. Adey, A. R. Boardman, B. Brooke, N. W. Maskell, D. H. Beckett, G. D. Cooper, G. N. Rushen, T. McGreevey, R. Howard, J. S. Mason, L. L. Flowerdew, J. Harvey, H. D. Steger-Lewis, T. S. Wilkinson, T. M. G. Bury, D. R. Levinson, P. M. S. Hedgeland, W. Sykes.

F/L. to S/L.: H. O. Stephens, R. C. Mitchell, W. A. McIlroy, M. J. McMenamin, R. S. Langton, R. S. Hogg, C. E. Heighton, K. W. Drabble, D. G. Evans, W. R. Jones, G. R. Roscoe, P. F. Reed, D. Dunford, J. W. Whitelegg, V. A. Knight, B. C. Twiss, D. W. Wallis, A. J. Pring, J. Littler, B. A. Ward, J. M. Beeby, C. B. Kay, D. Ball, P. G. Smith, R. L. Mills, D. W. Scott, G. R. D. Calder, B. D. Moore, J. Sheriff, J. S. Falvey, J. MacKenzie.

F/L. to S/L., Branch List: C. H. Lang, R. Hood, W. A. Greene, J. O. Shackleton.

Equipment Branch

W/C. to G/C.: A. G. Sutton, C. J. G. Ferguson, W. J. Maggs.

S/L. to W/C.: J. Trotman, D. J. Walliker, A. D. Rutherford-Jones, J. M. Stevenson, W. Kemplay, G. J. N. Neal, D. E. Longley, L. Baume, H. D. Campbell.

F/L. to S/L.: T. Roberts, G. A. Foss, T. E. Morris, A. Lyle, J. F. Barford, D. J. Cullen, W. R. Groves, H. C. Trent, T. F. Burd, R. J. Phillips, G. A. Jeffery, E. V. Hughes, M. G. Dyer, A. Hale, A. D. Harvey, A. J. W. Oliver, J. Tuck, G.N. V. Chignall, R. F. Carter, D. E. Peters, L. J. Jacobs, J. H. Cooke, F. W. Tame, W. G. Carr.

F/L. to S/L., Branch List: H. Pulman-Jones, H. R. Walton.

Flt/O. to Sq/O., W.R.A.F.: I. E. Smith.

Secretarial Branch

W/C. to G/C.: T. P. F. Trudgian, T. J. Hanlon, W. G. Morgan.

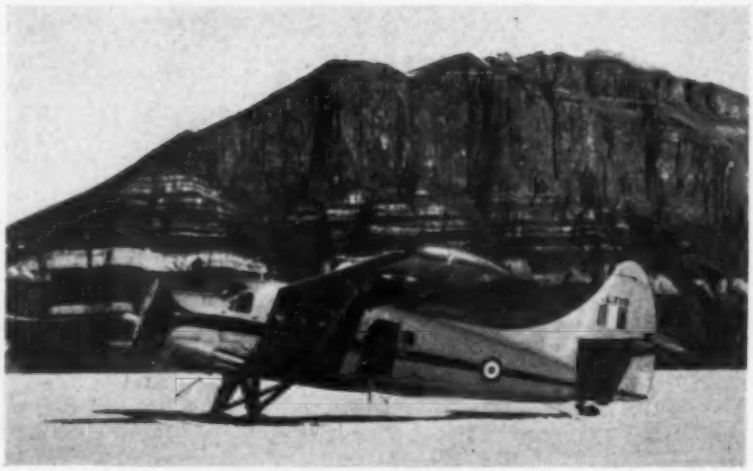
S/L. to W/C.: A. Powell, N. Storer H. A. G. Warren, D. A. Hine, C. H. Pocock, J. A. Ferguson, A. P. G. Holden, A. Vicary, F. Murray.

F/L. to S/L.: R. A. H. Smith, J. R. Austin, H. G. Harding, E. J. Brennan, J. Johnston, W. D. Blythe, J. A. G. Federico, L. W. Fletcher, E. M. Jackson, S. E. Attree, E. J. Baldock, R. J. Longstaff, R. C. Cawrse, D. R. Perrin, R. H. Merrifield, S. G. Head, E. A. Strange, F. G. Ireland, E. A. T. Sullivan, T. Williams, J. A. Gill, W. S. Jackson, R. T. Lang, E. T. Duckett, J. E. Bliss, E. F. Lapham.

F/L. to S/L., Branch List: A. Price, G. P. Owen.

Flt/O. to Sq/O., W.R.A.F.: B. J. Francis.

(To be concluded)



This D.H. Otter—XL 710—made history on January 6 when, flown by S/L. J. Lewis, it became the first single-engined aircraft to fly across the Antarctic. With S/L. Lewis as crew were F/L. G. Haslop, F/Sgt. P. Weston and Sgt. E. Williams. Together they form the R.A.F. Detachment (which also operates an Auster) stationed with the British Transantarctic Expedition.

IN BRIEF

A. V-M. H. P. Fraser, A.O.C. No. 12 Group, inspected members of No. 3621 (North Lancashire) F.C.U. at R.A.F. Squires Gate, Blackpool, on January 5, when the unit—one of three F.C.U.s in Lancashire which are being disbanded by the end of this month—held its final parade.

* * * * *

No. 101 Sqn., which is being formed to operate Vulcans, will be based at R.A.F. Finningley, near Doncaster.

* * * * *

A plaque of the badge of No. 2 Aircraft Delivery Unit, a wartime M.E. formation which supplied aircraft to squadrons of the Desert Air Force, was formally presented to the R.A.F. Reserves Club on January 8.

* * * * *

Following the stand-down parade of No. 3611 (West Lancashire) F.C.U. at R.A.F. Fazakerley last Sunday, when the reviewing officer was A. V-M. H. P. Fraser, mess silver belonging to the unit and to No. 611 (West Lancashire) Sqn., R.Aux.A.F. (disbanded last year) was handed over to the Lord Mayor of Liverpool, Ald. F. H. Cain, to be stored in Liverpool Town Hall.

* * * * *

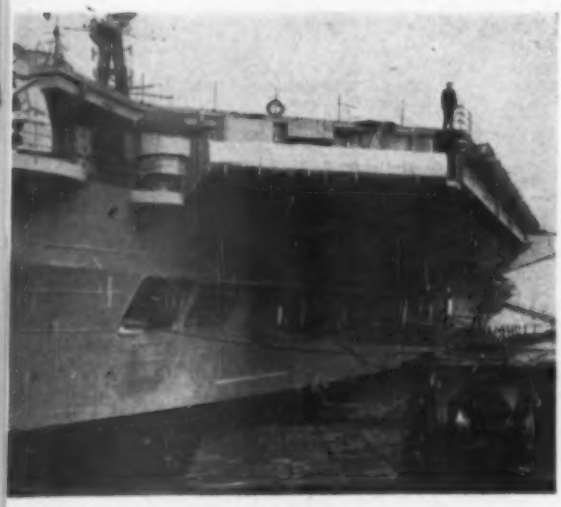
M.E.A.F. transport aircraft have been dropping supplies of D.D.T. to WHO teams combating malarial mosquitoes among the semi-nomadic Dyak tribes.

* * * * *

Miss Joyce Mugford has been appointed warden of the first convalescent home to be established by the Royal Air Forces Association for ex-R.A.F. and W.R.A.F. personnel. The home is in Clifton Drive South, St. Annes-on-Sea, and will be officially opened next month.

* * * * *

R.C.A.F. headquarters has announced that the Refresher Flying Training Plan, which since 1950 has provided ground and flight training for former R.C.A.F. pilots to enable them to attain a degree of proficiency for service in an emergency as staff pilots or instructors, is to be discontinued from the end of March this year.



Two views of H.M.S. "Victorious," the new aircraft carrier which was being commissioned at Portsmouth on January 14 (and formed the subject of an article in last week's issue). On the left, the overhang of the angled deck; and below, a view looking forward, showing the round-down.
"Flight" photographs

We design, manufacture and supply heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Viscount's anti-icing system. Similar units are supplied for the Fokker Friendship and the Bristol Britannia.

This thermal blanket is in refractory fibre cased in ·004 inch (·1016 mm.) stainless steel. It was made-to-measure, and is extremely light, the dimpled construction being responsible for its great strength. Specified for Rolls-Royce and Armstrong Siddeley jet and turbo-prop engines. Approved by the A.R.B. This example will be used on the Rolls-Royce Thrust Reverser of the De Havilland Comet.

High-pressure fuel-cooled oil cooler for high performance gas turbine engines. This unit is used in the Armstrong Siddeley Sapphire S.A.7.

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SUCCESS in our business doesn't merely mean the ability to manufacture, though we are extremely well equipped, even to the extent of having our own aluminium flux bath brazing plant.

Success, to us, means the ability to solve problems; to produce something that will do a new job, or perhaps an old job in never-before-experienced circumstances. And then, of course, to make it a practical and economical proposition.

We have enormous experience and wide resources. If we can help you in any way with heat control equipment, please contact us. We are always at your service.

We are now introducing Sealed Blankets for Civil Aircraft

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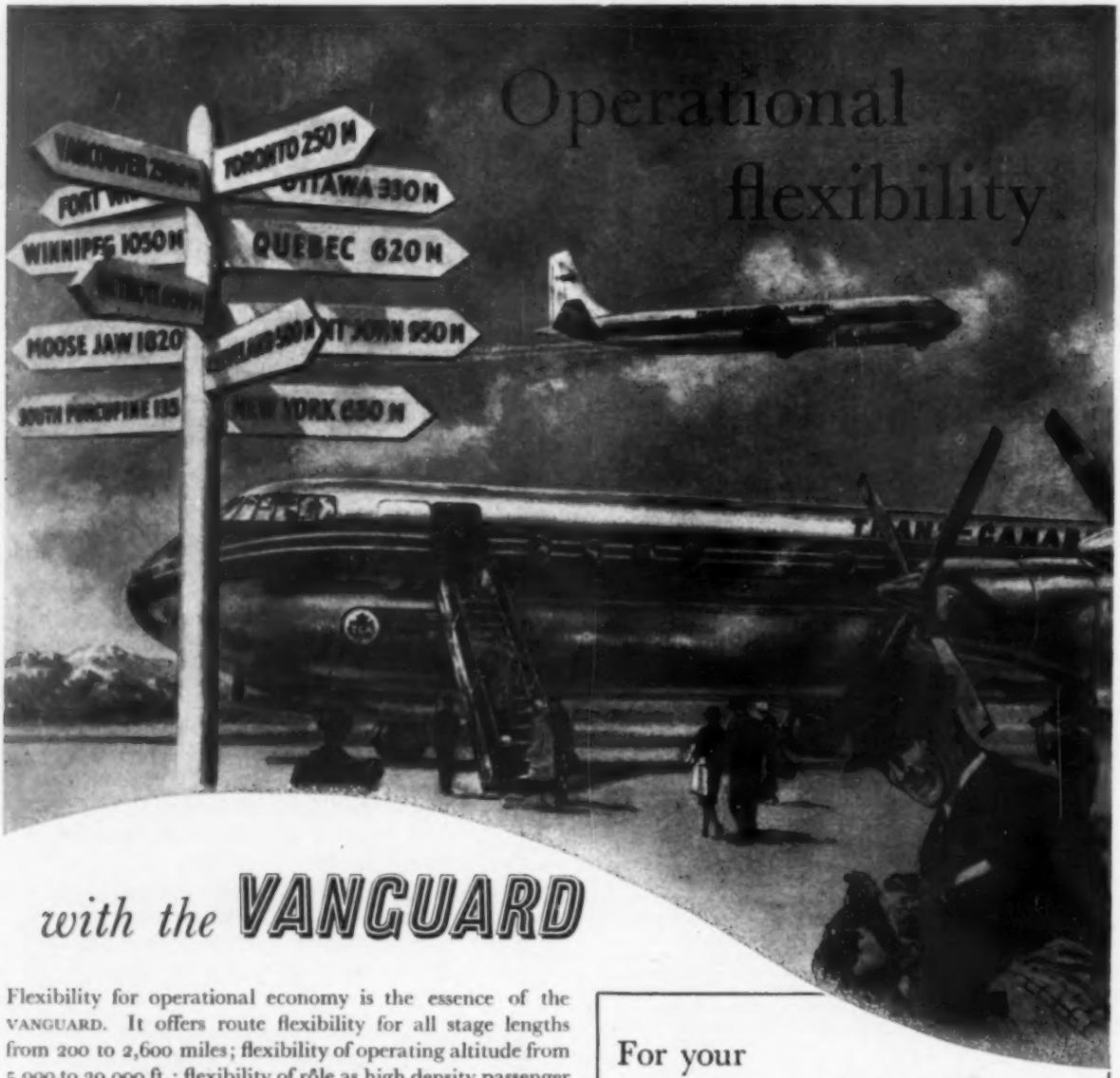
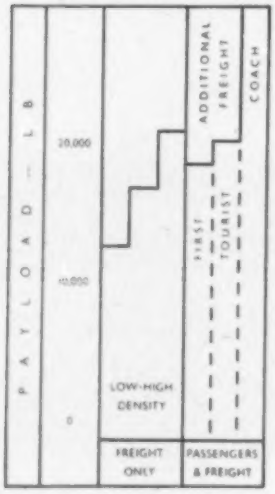


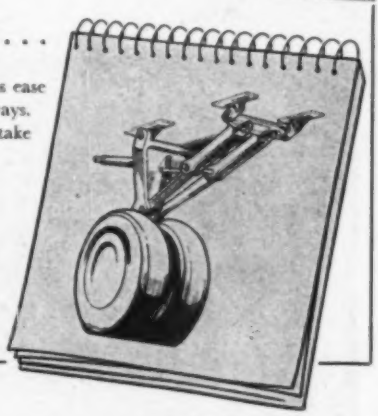
with the VANGUARD

Flexibility for operational economy is the essence of the VANGUARD. It offers route flexibility for all stage lengths from 200 to 2,600 miles; flexibility of operating altitude from 5,000 to 30,000 ft.; flexibility of rôle as high density passenger liner, luxury medium-haul or all-cargo services. With its 'double-bubble' fuselage the VANGUARD will carry up to 122 passengers in the top deck or ten tons of freight in the holds, or almost any combination of these up to a payload of 25,000 lb. At maximum payload, sea level standard day conditions (70° F), take-off length for 2,600 miles range is 6,500 ft. On a 1,750 miles sector this is reduced to 5,500 ft. With 20,000 lb. payload over 600 miles, 4,000 ft. is adequate. In effect the VANGUARD can operate from most regular airports in use to-day.



For your notebook . . .

Low-pressure tyres ease the stress on runways. Those which can take the VISCOUNT can also take the VANGUARD. Take-off and landing distances are modest.



VICKERS VANGUARD

FOUR ROLLS-ROYCE TYNE PROPELLER-TURBINE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT551

On its way to the final assembly building at the Douglas Long Beach plant is the first DC-8. The programme, which calls for roll-out next month and first flight in March, is on schedule. The aircraft will be ready to start its C.A.A. acceptance-trials in 12 months' time, and the first delivery for training flying will be in June 1959. Certification and delivery for service will begin in October 1959.

CIVIL AVIATION

1957—RECORD SAFETY YEAR

THE steady post-war downward trend in passenger fatality rates on scheduled air transport, interrupted in recent years, appears from preliminary figures to have been restored in 1957.

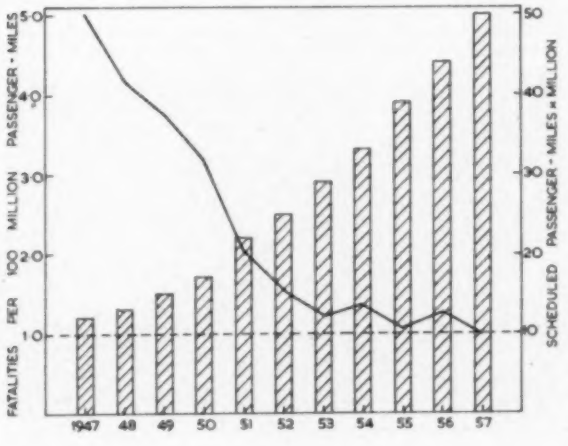
The ultimate goal for air transport is the complete elimination of fatality. In the meanwhile a less ambitious target attracts the attention of statisticians: this is the carriage of each 100 million passenger-miles with the loss of only one life. Pre-war rates never approached this level. Fatalities per 100 million passenger-miles dropped from 45 in the late twenties to 15 in the late thirties.

Post-war rates have reflected the improvements in aircraft design forced forward in the technological hothouse of world strife. Passenger fatality rates (per 100 million passenger miles) fluctuated between four and five until 1948, then fell until a rate of 1.1 was achieved in 1955. Exclusion of accidents resulting from sabotage and attack would have reduced that year's rate to 0.8—the first year in which the global rate fell below the "target" of one fatality per 100 million passenger-miles.

During 1956 the world's airlines failed to equal the previous year's record. Although in 1957 the downward trend was restored, it is unlikely that the rate of 0.8 fatalities shown for the record year of 1955 will be reached. Estimated traffic figures suggest that the 1957 rate will lie between 0.9 and 1.0.

These figures cover all scheduled services operated by I.C.A.O. member countries. (The only substantial outsiders are U.S.S.R. and China.) Great variations are seen between this global average and the rates for individual airlines and for separate regions.

As regards accident rates for individual airlines, it is often thought that size alone begets safety—i.e., that an airline which flies a very much greater number of passenger-miles in a given time than another will thereby tend to be the safer. There is no basis for such a conclusion. Nevertheless, there are some factors, such as frequency of service, which are related both to safety and to size. As flight frequency along a particular route increases so do safety rates improve. (This process is eventually halted by increased danger of collision.) These higher-frequency "popular" routes support a higher volume of traffic and tend to become the hunting grounds of the larger airlines. Only in this indirect way can the larger airlines' safety records benefit from size alone.



The origin of this association of size with safety is probably explained by the number of small airlines showing very poor safety records. Further research would reveal a much larger number of small operators with remarkably good records. These results suggest that for this group of airlines it is necessary to average safety rates over a long period of time.

It is also widely believed that because landing and take-off appear to be the most hazardous moments of flight, then short-haul airlines—those with the most landing and take-offs per distance flown—will tend to experience the worst rates. Such airlines do in fact report the greatest number of incidents. Yet it is a curious fact that these same carriers invariably show the safest rates when it comes to major accidents and disasters. This paradox is partly explained by the high flight-frequency—and consequently greater degree of route familiarity—normally associated with short-haul operations. Another factor is that the shorter the duration of flight the less is the probability of *en route* snags developing. Exceptional safety records are common to short-haul carriers such as Capital and Colonial (now merged with Eastern) in the U.S., and Silver City and Finnair in Europe. The routes potentially most dangerous in theory are often the safest in practice. No airline illustrates this better than Garuda Indonesian Airways. Operating short over-water sections, under extremely adverse climatic conditions, they have never had a passenger fatality.

Wide difference in fatality rates are also experienced as between various regions. Whereas the global average is tending towards one fatality per 100m passenger-miles, two regions—North America and Australasia—have for some years been experiencing annual rates below this figure. European and African airlines show average rates respectively of about three and four passenger fatalities. The poorest regional rates are experienced in Latin America, Asia and the Middle East, passenger fatalities per 100m passenger-miles ranging between five and seven. The "safe" regions tend to be climatically favoured—conditions of bad visibility, high humidity or severe turbulence are not general. Such regions are also economically better suited insofar as large volumes of air traffic on the one hand result in a greater degree of route familiarity, and on the other hand permit the provision of superior facilities—aircraft, ground equipment and personnel. Both increased familiarity and improved facilities contribute to safety.

IRISH TRANSATLANTIC PLANS

IRELAND'S dream of her own transatlantic air service reached a stage nearer reality on January 3 when the Minister for Industry and Commerce, Mr. Sean Lemass, stated in Dublin that Aer Linte Teoranta, the transatlantic airline founded in 1947, is to resume active operations in April this year. Lockheed Super Constellations are to be leased (on a mileage basis) from Seaboard and Western Airlines, Inc., and will fly into Shannon from New York and Boston, continuing from there to Dublin as aircraft re-chartered to Aer Lingus. An all-the-year-round frequency of three return flights weekly, with a daily service during the tourist season, is envisaged. Fares will be at tourist level.

Aer Linte has always been wholly owned by Aer Rianta, which is also the majority shareholder in Aer Lingus, but it is believed that Seaboard and Western Airlines will take up a token holding in the Irish airline. The plan is almost certain to be opposed by both PanAm and T.W.A., who have been denied Fifth Freedom rights at Dublin, principally because the Irish Government has stood firm against any plan to by-pass Shannon Airport (which represents a £5¼ million State Investment). The re-chartering arrangement is intended to forestall their objections.

Aer Linte Teoranta (Airlines Limited) was founded to operate transatlantic services and was to commence operations in 1948. Five Lockheed L.749 Constellations had been delivered in September 1947, when the Coalition Government decided to abandon the service. The aircraft were sold to B.O.A.C. in June 1948, after being chartered to Aer Lingus for the previous nine months. In 1953 the project was reactivated when C.A.B. granted their approval to an agreement between Aer Linte and Seaboard and Western Airlines to operate transatlantic services, but the fact that this was only for a period of two years led to the scheme being abandoned for a second time.

CIVIL AVIATION . . .

B.E.A.'s JET ORDER: The Final Phase

AS each recent issue of *Flight* has gone to press it has appeared ever more likely that events would forestall our information and speculation about B.E.A.'s choice of jet. Once again the placing of the order seems imminent, and hope was officially expressed last week that by yesterday, January 16, the final decision would have been made.

If the outcome is indeed made known today, the structure of much of the British aircraft industry will have changed radically in the past week: perhaps even more radically than in the preceding momentous weeks when the industry manœuvred and regrouped behind the two contending jet designs—the Bristol 200 and D.H.121—of the Hawker Siddeley, Bristol and D.H. trio. Yet the Corporation's order does not await the technical choice between these designs so much as the Government's determination first to extract the maximum integration from the industry.

The Government's intention is to buy, with the £20m investment that the order represents, the best design team for B.E.A., the biggest grouping for the M.T.C.A. and the strongest financial bloc for the Ministry of Supply. They also want to buy a team that will tackle—in perhaps five years' time—the next airliner project for which there is a Corporation and world demand. It will be exciting, and it will be expensive, and the Government are trying to form now the team that will undertake the research needed to build it. They want to see Hawker Siddeley, Bristol and de Havilland all actively involved.

This is a bold policy, but not a foolhardy one. The onus, as never before, is upon the industry, for they will have made the decision, during this final week of negotiation, as to the degree of amalgamation they are prepared to accept.

For the country to compete successfully in world markets, the maximum experience of success must be brought to bear. Integration to provide financial strength is patently necessary, but neither are all the technical aces held in one hand. And it would be wrong to believe that only established teams can be successful ones. The important ingredients of teamwork are competence and mutual respect, qualities spread in abundance throughout the industry.

The peril of amalgamation is that the shakedown period for the new team and its chosen leadership is perilously short, because the export success of B.E.A.'s jet depends upon competitive delivery and competitive service; competitive performance is a less significant factor. The success of the industry's shotgun marriage will depend upon the willingness of the parties involved. The union must be made a happy one long before the baby is born.

With a decision apparently imminent, the controversy continues to boil as we go to press. One independent observer writes:—

"Unless we are all very careful, we shall bungle B.E.A.'s new jet airliner. It is now plain that the Government are not 'encouraging' the industry to regroup: they are shotgunning it. They are saying to B.E.A. and to the industry, in so many words: 'Because it is we who have to find the £20 million to lend B.E.A., we are the customer; and as the customer we intend to have the product made in the way we want it made.'

"This is a maladroit conception of a customer's privileges. The man who pays the piper may not get his tune at all if he insists on a particular style of playing.

"The Government's objective—to consolidate the industry and to erase decades of ministry-contract mindedness from it—are commendable enough. But these ends are being pursued with precipitous disregard for two facts of life.

"First, a successful aeroplane is *not* the product of strong finances and technical resources alone—indispensable though these things are. Capital and computors, test-rigs and tunnels cannot take basic design decisions. They can only provide the means by which the board brushwork of a design can be developed into a finished, homogeneous work. The project and design stage of an aircraft must be the expression of team experience and expertise. No patron of the arts would commission three Academicians, however much each was starving in his garret, to paint one portrait. Which one would do the broad brushwork? Which one would say 'This is the correct way' on an issue which was neither black nor white? There are many such issues in aeronautical engineering. And which one would deal with the client, and take the rap for the poor final result?

"Second—if it is agreed that there must be one design-leader an airline must be free to choose that design-leader. No one with any knowledge of the aircraft business has yet suggested that B.E.A.'s evaluation of the contending designs was purely a technical one. There is probably not one ha'porth of technical difference between the draft specifications tendered by Avro, Bristol and de Havilland. The fact is that an airline buys a new type of aircraft knowing that its engineers, flying staff and executives are going to have to live and work closely with the aircraft firm concerned—day in and day out—for the next seven or eight years. Technical competence is perhaps 20 per cent of a successful transport aeroplane; the rest is commercial airliner *savoir faire*. Many aircraft firms claim to possess this—except, significantly, those who have had a major transport aircraft in commercial service for five years. These firms (Vickers are the only one in this country, and no doubt B.E.A. would have liked to work with them on the short-range jet) will say that five years of operational feedback, percolating through every department of the company, are needed to qualify for graduation from amateur commercial status. The point is this: an airline chooses much more besides nuts and bolts, and its judgment of what constitutes the much-more-besides must be respected.

"A good aeroplane, therefore, is more than a product of financial and technical resources: it is the product of a clearly recognized design leadership. And an airline wants more than an aeroplane: it wants it backed up with what, in its own judgment, is the best commercial airliner knowhow. Unless these things are appreciated Britain may make a mess of this short-range jet airliner.

"Let B.E.A. engineers make their choice. Then, with the principle of private financing (and no public rescue operations) clearly established, the rest—industrial regrouping included—will follow naturally."

HOW GROWS IT?

THE few weeks before Christmas always see I.C.A.O. statisticians busily drawing up provisional annual statistics for the closing year. With commendable promptness these figures are released to an industry impatient to learn about its own progress.

Passenger traffic is estimated to have increased by 16 per cent, reaching a level described by I.C.A.O. as "the equivalent of flying two million people all around the world." But the percentage growth figure given for air freight is 11 per cent, and for airmail a paltry seven per cent.

Production of these statistics so rapidly is an exercise in heroic extrapolation. Only the more diligent member-States will have been forwarding their monthly statistics to Montreal with sufficient alacrity to provide I.C.A.O. with an accurate picture of their progress until late autumn. A number of others will have returned figures covering only the early months of the year.

Year	Miles flown	Hours flown	Passengers carried	Passenger-miles	Cargo ton-miles	Mail ton-miles	Average Number of		
							Passengers per aircraft	Miles flown per passenger	Miles flown per hour
	(millions)								
1957	1,760	8.8	87	51,000	1,150	300	29	585	202
1956	1,510	8.0	77	44,000	1,030	280	28	575	200
1955	1,430	7.4	68	39,000	910	260	27	570	195
1954	1,290	6.7	58	33,000	770	230	26	565	190
1953	1,190	6.4	52	29,000	720	190	24	560	185
1952	1,100	6.0	46	25,000	680	180	23	545	183
1951	1,010	5.6	42	22,000	640	170	22	520	180
1950	890	5.0	31	17,000	530	140	19	540	177
1949	840	4.8	27	15,000	390	130	18	545	175
1948	790	4.6	24	13,000	290	120	17	550	170
1947	710	4.2	21	12,000	180	90	17	560	165
1946	580	3.8	18	10,000	80	70	17	530	155
1945	370	2.5	9	5,000	70	90	13	545	150

The sharp rise in average miles per passenger in 1957 suggests that much of last year's growth came from a rapid increase in long-distance air travel.

Many returns will contain discrepancies which require patient investigation, often accompanied by protracted correspondence.

The estimatory nature of these provisional I.C.A.O. statistics allows an outsider to question their precise accuracy. U.S. carriers are now known to have increased their passenger and freight traffic by 14 per cent and 19 per cent respectively. If I.C.A.O. statistics are accurate, then non-U.S. airlines appear to have increased their passenger traffic by as much as 19 per cent, while their freight traffic has grown by only seven per cent. It will be interesting to compare these rates with those reported in the next few weeks by each of the world's airlines.

SEABOARD MAIL CARRIER

SEABOARD and Western, the transatlantic all-freight airline (whose part in assisting Eire to establish a transatlantic service is referred to on p. 93) have been authorized by the Civil Aeronautics Board to carry foreign mail. The airline's permit, contained in their "Certificate of Public Convenience and Necessity," extends to the United Kingdom, Ireland, Belgium, Holland, France, Switzerland and Germany, and the first mail shipment was carried from Ireland to Idlewild on January 5. Major cities in each of these countries are served by Seaboard and Western's daily freight services to New York.

MORE BRITANNIA WORK FOR SHORTS

TO alleviate redundancy at Short Brothers and Harland during 1958 the Ministry of Supply has re-shuffled Britannia production to increase the Belfast firm's production commitment. In a letter to Col. A. McKibbin, M.P. for East Belfast, the Parliamentary Secretary to the Ministry of Supply, Mr. W. S. Taylor, has promised more work for Shorts on the Britannia 253s for Transport Command. Shorts have been working on the first ten complete aircraft and components for a further three. The order was increased last November from 13 to a total of 20 aircraft, of which Belfast will now build 15 and manufacture parts for the additional five; these will be assembled at Bristol.

The company are also building five of the six aircraft for C.P.A.L. (the first aircraft is complete and made its first flight on January 11), five for Northeast (one of which is now being finally furnished at Bristol) and three aircraft for the M.o.S., destined for independent trooping. The Aeronaves de Mexico Britannias, both of which are now in service, were also built at Belfast.

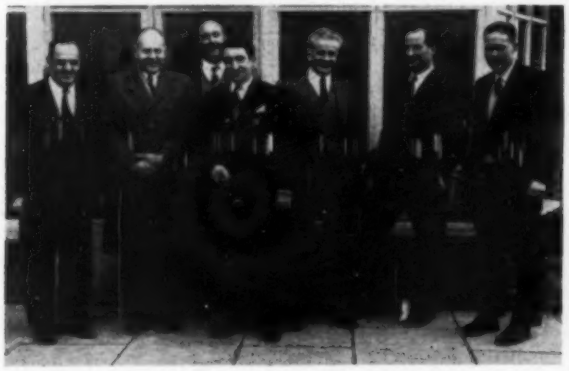
SCREENED-COCKPIT AWARD

AN award of £200 has been made to Capt. B. E. E. Marshall, deputy commander of the Civil Aviation Flying Unit, M.T.C.A., Stansted, under the Civil Service staff suggestions scheme, for an original system of slatted screens and panels for use in instrument-flying training. The screens are so placed that the pilot under instruction or examination can see inside the cockpit only, while the vision of the accompanying safety pilot remains virtually unrestricted.

This effect is achieved by the angles at which the screens are mounted; the safety pilot (in the right-hand seat) sees each of them edgewise and, therefore, has only thin lines across his view, whereas the examinee in the left-hand seat sees them plan-form, where they overlap to obstruct his view completely. One of the screens has a sliding panel which is opened to allow the pilot to see the runway when he is taking-off and is closed soon afterwards to simulate entry into cloud at a low altitude; the process can, of course, be reversed to permit visual landing after a blind approach.

This system of screens has been used since August 1955 in the five Doves operated by the examining section of the M.T.C.A. civil aviation flying unit for the testing of instrument rating candidates—a period covering about three thousand flights.

These angled screens can be used at night (tinted goggles and amber screens are sensitive to conditions of light and to condensation), a feature which represents a saving to the flying unit of several thousand pounds a year. Other operators have appreciated the advantages of the system, say the M.T.C.A., and either purchased identical equipment or applied the principles to their particular aircraft. A congratulatory letter has been sent by the Minister to Capt. Marshall.



Eagle's new Viscount 805, G-APDW, made its inaugural flight to Hamburg on Christmas Eve. It is seen here at Fuhlsbuttel airport before returning to Blackbushe.

BREVITIES

AN El Al Britannia regained the transatlantic air transport record from B.O.A.C. on January 9, with a flight from New York to London in 7 hr 44 min. The aircraft was flown by Capt. Colman Goldstein.

* * *

Mr. Keith Granville, commercial director of B.O.A.C., has been appointed deputy managing director of the Corporation.

* * *

The second Viscount 808 for Aer Lingus, EI-AJJ "Cillian," was delivered to Dublin on January 11.

* * *

The death was announced earlier this month of Dr. Rudolf F. Heberlein, chairman of Swissair since 1951.

* * *

It is reported from America that Capital are to postpone payments to Britain for their Viscounts until after the first quarter of 1958.

* * *

American Airlines have abandoned the "living-room look" planned for its Electras in favour of a 68-seat arrangement with a small table on the centre armrest of each seat.

* * *

Alaska Airlines have applied to the C.A.B. for an extension of its routes to Russia for the summer of 1958. Specific routes asked for are: Anchorage, Fairbanks and Seattle *via* Nome to Irkutsk.

* * *

Twelve first-class seats will be introduced on to Eagle Viscount 805 services between Manchester - Hamburg - Copenhagen on February 3. There will be 40 tourist-class seats in the forward section of the cabin.

* * *

MALEV, the Hungarian airline, is to introduce regular Budapest - Berlin - Copenhagen and Budapest - Tirana services with Il-14s, this month. Social and trade union organizations are being offered cheap group domestic flights.

* * *

Reports from Holland indicate that K.L.M. are interested in Twin Pioneers for domestic services in Holland, and for services from Hamburg and Borkum in Germany, and Spa in Belgium, to Schiphol. A figure of ten Twin Pioneers has been mentioned.

* * *

Qantas have completed their inaugural Super Constellation round-the-world flight. The regular service was due to start on January 14. Aircraft were to fly eastwards and westwards from Sydney, and should land within a few hours of each other at London today.

* * *

The M.T.C.A. draw attention to changes in the Air Navigation Order, 1954, and the Air Navigation (General) Regulations, 1954, regarding operating crew, navigation lights, flotation equipment, military pilots, safety devices and the carriage of a steward or stewardess on public transport aircraft.

Two senior B.O.A.C. engineers, Mr. Charles Abel and Mr. M. W. Anderson, recently visited Smiths Aircraft Instruments to inspect S.E.P.2 production. L. to r.: Mr. Abel; Mr. R. Sisson, technical services manager, S.A.I.; Mr. K. Fernside, research manager, S.A.I.; Mr. G. G. Roberts, technical director, S.A.I.; Mr. J. Rivaz, technical sales manager, S.A.I.; Mr. Anderson; and Mr. A. M. A. Majendie, director of operational requirements, S.A.I.

CIVIL AVIATION . . .

THE AIRLINES' SHOPPING LIST

(Correct to January 13, 1958, excluding options, but including certain government and executive orders)

SINCE the last edition of this *Flight* list (September 13, 1957) the market has been quiet—though by no means static. The total number of new aircraft delivered or on order has increased since last September from 1,481 to 1,506. Of the 39 new aircraft sold, 13 were jets and 26 were turboprops. Piston engine orders dropped by 14.

One new variant of an existing type was added to the list, when United Air Lines ordered 11 Boeing 720 medium jets in November. One type, the Frye Safari, has been temporarily removed from the list until its future appears to be more definite. The first short-range jet will be included—B.E.A. must surely hope— in the next edition of this list.

Although the new American transports are on schedule, and indeed ahead of schedule, it seems that many of the airlines who have ordered them will not break their hearts if delivery is late. The fares controversy—brought about as much by the airlines' 1955-56 buying spree as by rising costs—must be settled before the procurement business returns to normal.

It is far from normal at the moment: an airline can now be offered delivery of a Boeing 707, DC-8 or Electra *earlier* than it could a year ago. Northwest, for example, are in this fortuitious buying position. There are plenty of customers apparently willing to forgo a place in the queue to give themselves more financial breathing-space.

This "buyers'-market" situation is particularly unsettling for those manufacturers whose new aircraft are still not ordered in break-even quantities.

Aircraft	Variant	Powerplant	Airlines (listed in order of purchasing)	Total
Douglas DC-8	Overseas or Long-Range	Pratt and Whitney JT4	PanAm, 21 (December, 1959); United, 18 (Mid 1959); K.L.M., 8 (March 1960); Eastern, 18 (Mid 1959); J.A.L., 4 (September 1960); S.A.S., 7 (March 1960); Panagra, 4 (February 1960); Swissair, 3 (March, June, October 1960); U.A.T., 3 (March, April, May, 1960); T.A.I., 2 (June 1960); Olympic, 2 (1960)	133
	Domestic	Rolls-Royce Conway	T.C.A., 6 (March 1960)	
		Pratt and Whitney JT3	United, 23 (May 1959); National, 6 (August 1959); Delta, 8 (June 1959)	
Boeing 707	120	Pratt and Whitney JT3	PanAm, 6 (December 1958); American, 30 (operation on March 15, 1959); Continental, 4 (May 1959); T.W.A., 15 (from April 1959); Qantas, 7 (May to September 1959)	150
	220	Pratt and Whitney JT4	Braniff, 5 (October 1959)	
	320	Pratt and Whitney JT4	PanAm, 17 (March 1959); Air France, 17 (November 1959); Sabena, 4 (December 1959); T.W.A., 18; Cubana, 2 (March, June 1960)	
	420	Rolls-Royce Conway	Lufthansa, 4 (Summer 1960); Air India, 3 (early 1960); B.O.A.C., 15 (1960); Varig, 3 (July 1960)	
Boeing 720	—	Pratt and Whitney JT3	United, 11	11
Bristol Britannia	102	Proteus 705	B.O.A.C., 15	77
	250	Proteus 755	R.A.F. Transport Command, 20; M. of S., 3	
	300 series	Proteus 755	M. of S., 1; Northeast, 5 (mid-1958); Aeronaves de Mexico, 2	
	310 series	Proteus 755	B.O.A.C., 18 (current); El Al, 3; C.P.A.L., 6 (February, 1958); Hunting-Clan, 2; Cubana, 2 (late 1958)	
Douglas DC-7C Seven Seas	—	Wright R-3350	PanAm, 25; Swissair, 5; S.A.S., 14; Sabena, 10; Braniff, 7; B.O.A.C., 10; K.L.M., 11; Northwest, 14; Panair, 4; T.A.I., 3; Alitalia, 4; C.M.A., 4; J.A.L., 4	115
Lockheed L.1649A	—	Wright R-3350	T.W.A., 25; Air France, 10; Lufthansa, 4	39
Convair 440 Metropolitan	—	Pratt and Whitney R-2800	R.E.A.L., 10; S.A.S., 16; Finnair (Aero O/Y), 3; Sabena, 12; Swissair, 12; Iberia, 5; Continental, 3; National, 6; Delta, 8; Eastern, 20; Braniff, 5; Alitalia, 2; Jugoslavia (JAT), 2; Lufthansa, 5; Air Carrier Service, 3; R.A.A.F., 2; U.S.A.F., 6; Corporate customers, 12; Karhumaki Airways, 2; Ansett, 7; Italian A.F., 1; Cruzeiro do Sul, 4; Garuda, 3 (Spring 1958)	149
Sud-Est Caravelle		Rolls-Royce Avon RA.29	Air France, 12 (late 1958 to late 1960); S.A.S., 6 (April-October 1959); Varig, 2 (June, November 1959)	20
de Havilland Comet	4	Rolls-Royce Avon RA.29	B.O.A.C., 19 (mid-1958)	25
	4B	Rolls-Royce Avon RA.29	B.E.A., 6 (late 1959 to spring 1960)	
Lockheed Electra		Allison 501	Eastern, 40 (October 1958); American, 35 (January 1959); Braniff, 9 (May 1959); National, 23 (April 1959); K.L.M. 12 (September 1959); Western, 9 (September 1959) Allison, 1 (June 1958); Loftleidir Icelandic Airlines, 2; Braathens, 1; Ansett-A.N.A., 4; Garuda, 3; Pacific Southwest, 3; Cathay Pacific, 2 (June, August 1959); Aeronaves de Mexico, 3	149
Vickers Viscount	700 & 800 series	Rolls-Royce Dart	*See list below*	382
Vickers Vanguard	950 series	Rolls-Royce Tyne	B.E.A., 20 (March 1960); T.C.A., 20 (August 1960)	40
Vickers VC.10	135 seats	Rolls-Royce Conway	B.O.A.C., 35 (1963)	35
Convair 880		General Electric CJ-805	T.W.A., 30 (late 1959); Delta, 10 (1959); Transcontinental, S.A., 4; R.E.A.L., 4 (late 1959)	48
Fokker F.27 Friendship	Fokker-built	Rolls-Royce Dart	K.L.M., 2; Aer Lingus, 5 (late 1958); T.A.A., 6 (early 1959); Dutch Government, 1; "an Italian company," 1; Braathens, 3; Australian Government, 2; Iranian Oil, 2; Trabajos Aereos y Enlaces (Spain), 3 (spring 1959); Philippine Air Lines, 2 (late 1959); Sabena, 12; Belgian Air Force, 6	109
	Fairchild-built		West Coast Air Lines, 6 (March-October 1958); Mackey, 2 (March 1958); Frontier, 4 (October, 1958); Bonanza, 3 (May-June 1958); Piedmont, 12 (April-October 1958); General Tire and Rubber, 1 (1958); Continental Can Co., 1 (1958); Quebecair, 2 (August-September 1959); other U.S. executive versions, 10; Aerovias Ecuatorianas, 1 (November 1958); Northern Consolidated, 3 (October 1958-April 1959); Southwest Airlines, 3 (September-October 1958); Wheeler Airlines (Quebec), 2 (February-March 1959); Avensa, 5 (July 1958-January 1959); Wien Alaska, 3 (February-April 1959); Butler Aviation, 1 (exec., 1959); Bank of Mexico, 1 (exec., 1959)	
Handley Page Herald		Alvis Leonides Major or Rolls-Royce Dart 527	Queensland Airlines and A.N.A. (options)	24

Vickers-Armstrongs Viscount (all models). The following list of confirmed orders accounts for 382 aircraft, as follows: B.E.A., 27 V.701 (Dart 505), 24 V.802 (Dart 510), 16 V.806 (Dart 520); B.W.I.A., 8 V.702 (Dart 506); Aer Lingus, 4 V.707 (Dart 505); 3 V.808 (Dart 510); Air France, 12 V.708 (Dart 505); T.A.A., 7 V.720 (Dart 505/6), 7 V.756 (Dart 510); Indian Air Force, 1 V.723 (Dart 506), 1 V.730 (Dart 506); T.C.A., 15 V.724 (Dart 506); 36 V.757 (Dart 506); Hunting-Clan, 3 V.732 (Dart 506); 2 V.759 (Dart 510)*; Pakistan Government, 1 V.734 (Dart 506); Iraqi Airways, 3 V.735 (Dart 506); 1 V.773 (Dart 506); Fred Olsen, 2 V.736 (Dart 506), 4 V.779 (Dart 510); Canadian Government, 1 V.737 (Dart 506); Misrair, 5 V.739 (Dart 506); Capital, 3 V.744 (Dart 506), 57 V.745 (Dart 510); Butler Air Transport, 2 V.747 (Dart 506); Central African Airways, 5 V.748 (Dart 510); L.A.V., 3 V.749 (Dart 506); B.O.A.C., 3 V.754 (Dart 510); Hong Kong, 2 V.760 (Dart 510); U.B.A., 3 V.761 (Dart 510); Hughes Tool Co., 1 V.763 (Dart 510); U.S. Steel Corp., 3 V.764 (Dart 510); Standard Oil, 1 V.765 (Dart 510); Indian Airlines, 10 V.768 (Dart 510); K.L.M., 9 V.803 (Dart 510); Transair, 3 V.804 (Dart 510); New Zealand N.A.C., 3 V.807 (Dart 510); Continental, 15 V.812 (Dart 525); South African Airways, 7 V.813 (Dart 525); Iranian Government, 3 V.782 (Dart 510); Lufthansa, 9 V.814 (Dart 525); Philippine Air Lines, 2 V.784 (Dart 510)†; L.A.I., 10 V.785 (Dart 510); South African Government, 1 V.781 (Dart 510); Pakistan Air Lines, 3 V.815 (Dart 525); Cubana, 3 V.755 (Dart 510), 4 V.818 (Dart 525); Lloyd Aero Colombiano, 3 V.786 (Dart 510); Brazilian Government, 1 V.742, 1 V.789 (Dart 510); P.L.U.N.A., 3 V.769 (Dart 510); Niarchos, 1 V.819 (Dart 525); Black Lion Aviation, 1 V.825; Eagle Aviation, 2 V.805; Turkish Air Lines, 5; V.A.S.P., 5 V.827; T.A.P., 3 V.810; Ansett-A.N.A., 4 V.810.

* *The 759s sold to Icelandair.*

† *One leased to T.A.C.A.*

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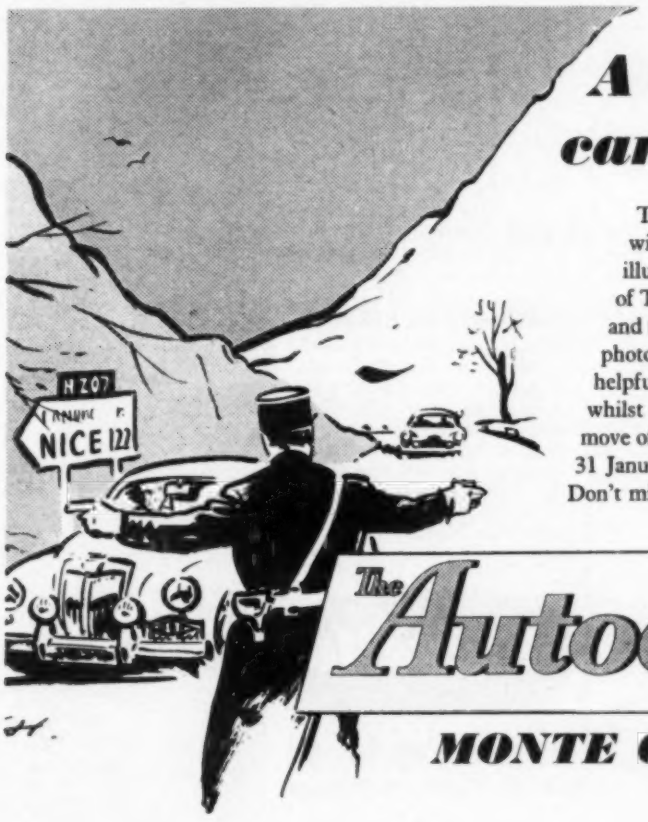

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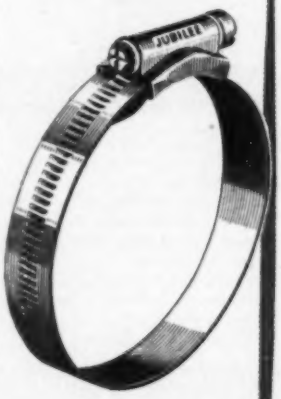

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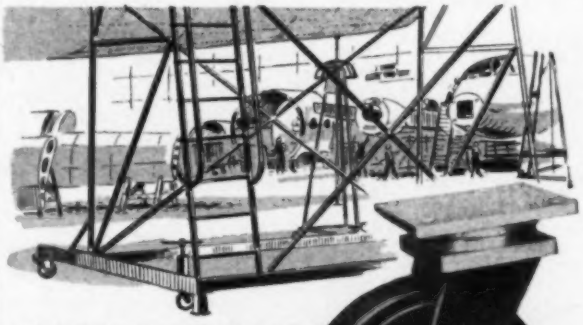

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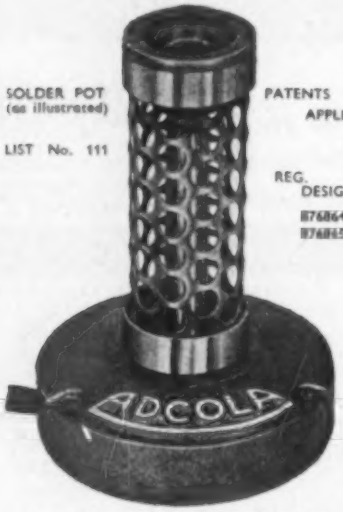

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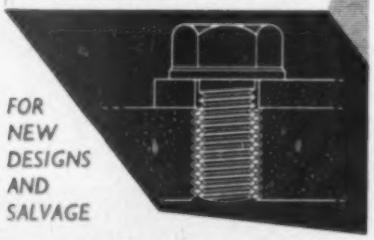

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APPLICATION No. 193/6 for an increase in frequency to one return weekly on the Colonial Coach Service which they are authorised to operate with Avro York and Hermes aircraft on the route London (Stansted)-Malta (Luqa)-Cyprus (Nicosia) at a frequency of one return flight fortnightly, and for commission to carry up to ten passengers, between London and Malta on each flight.

APPLICATION No. 528/2 from B.K.S. Air Transport Ltd., of 1 Marylebone High Street, London, W.1, for an amendment to the terms of approval of the Normal Scheduled Service which they are authorised to operate with Dakota and Viking aircraft on the route Southend-Bordeaux (tech)-Bilbao (Sondica) and/or Santander at a frequency of two return flights weekly, so as to permit them to operate the service also from London Airport.

FROM Derby Aviation, Ltd., of Derby Airport, Burnaston, Derby:—

(a) Application No. 143/8 for an amendment to the terms of approval of the Seasonal Normal Scheduled Service which they are authorised to operate on the route Nottingham (Tollerton) and/or Derby (Burnaston)-Wolverhampton (opt)-Birmingham (Elmdon) or Southampton (Eastleigh) (tech stops)-Jersey from May to September inclusive each year and which they have previously applied to operate from March to October inclusive each year with an optional traffic stop at Guernsey, so as now to permit the service to operate throughout the year and a traffic stop to be made at Birmingham (Elmdon) from 1st November to 31st March each year.

(b) For the following Seasonal Normal Scheduled Services to be operated with Marathon, Dakota and later Herald aircraft for the carriage of passengers, supplementary freight and mail at an initial frequency of two return flights weekly on each service increasing later to three return flights weekly from April to October inclusive each year for seven years from April, 1958:—

APPLICATION No 1578 for a service on the route Derby-Nottingham (opt)-Birmingham-Luxembourg.

APPLICATION No. 1579 for a service on the route Derby-Nottingham (opt)-Birmingham (tech)-Coventry (Baginton) (opt)-Lyons (tech)-Nice.

APPLICATION No. 1580 for a service on the route Derby-Nottingham (opt)-Birmingham-Toulouse (tech)-Perpignan.

APPLICATION No. 1581 for a service on the route Derby-Nottingham (opt)-Birmingham (tech)-Le Touquet (opt)-Beauvais.

APPLICATION No. 1582 for a service on the route Derby-Nottingham (opt)-Birmingham-London (Blackbushe) (opt)-Lyons (tech)-Corsica (Bastia).

APPLICATION No. 1583 for a service on the route Derby-Nottingham (opt)-Birmingham (opt)-Lyons (tech)-Albenga.

APPLICATION No. 1584 for a service on the route Derby-Nottingham (opt)-Birmingham (tech)-Toulouse (tech)-Palma.

APPLICATION No. 1587 for a service on the route Derby-Nottingham (opt)-Birmingham (opt)-Cardiff (opt)-Nantes (tech)-Bilbao.

(c) For the following services to be operated with Marathon, Dakota and later Herald aircraft for the carriage of passengers, supplementary freight and mail at an initial frequency of one return flight daily on each service increasing later to two return flights daily for seven years from April, 1958:—

APPLICATION No. 1585 for an Internal Service on the route Derby-Nottingham (opt)-Belfast.

APPLICATION No. 1586 for a Normal Scheduled Service on the route Derby-Nottingham (opt)-Birmingham (tech)-Rotterdam.

THESE applications will be considered by the Council under the Terms of Reference issued to them by the Minister of Civil Aviation on 30th July, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7471

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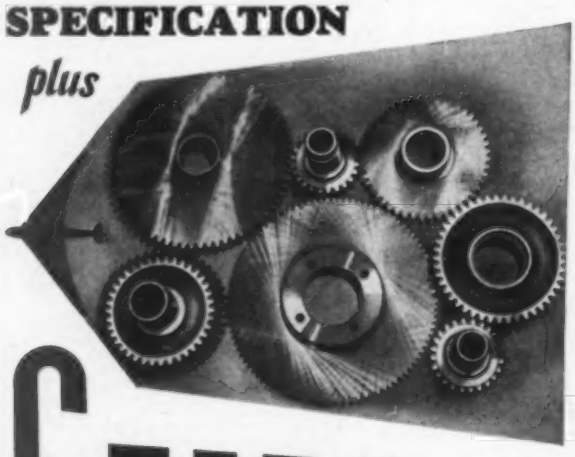

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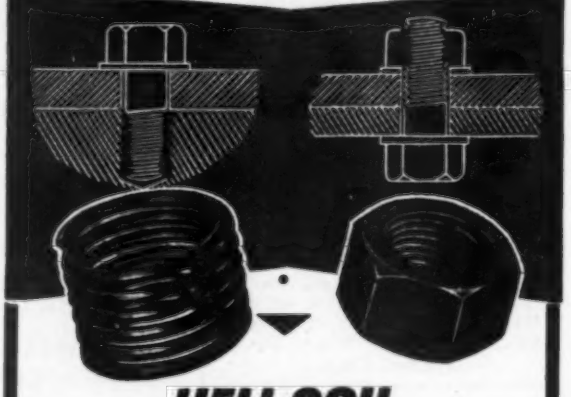

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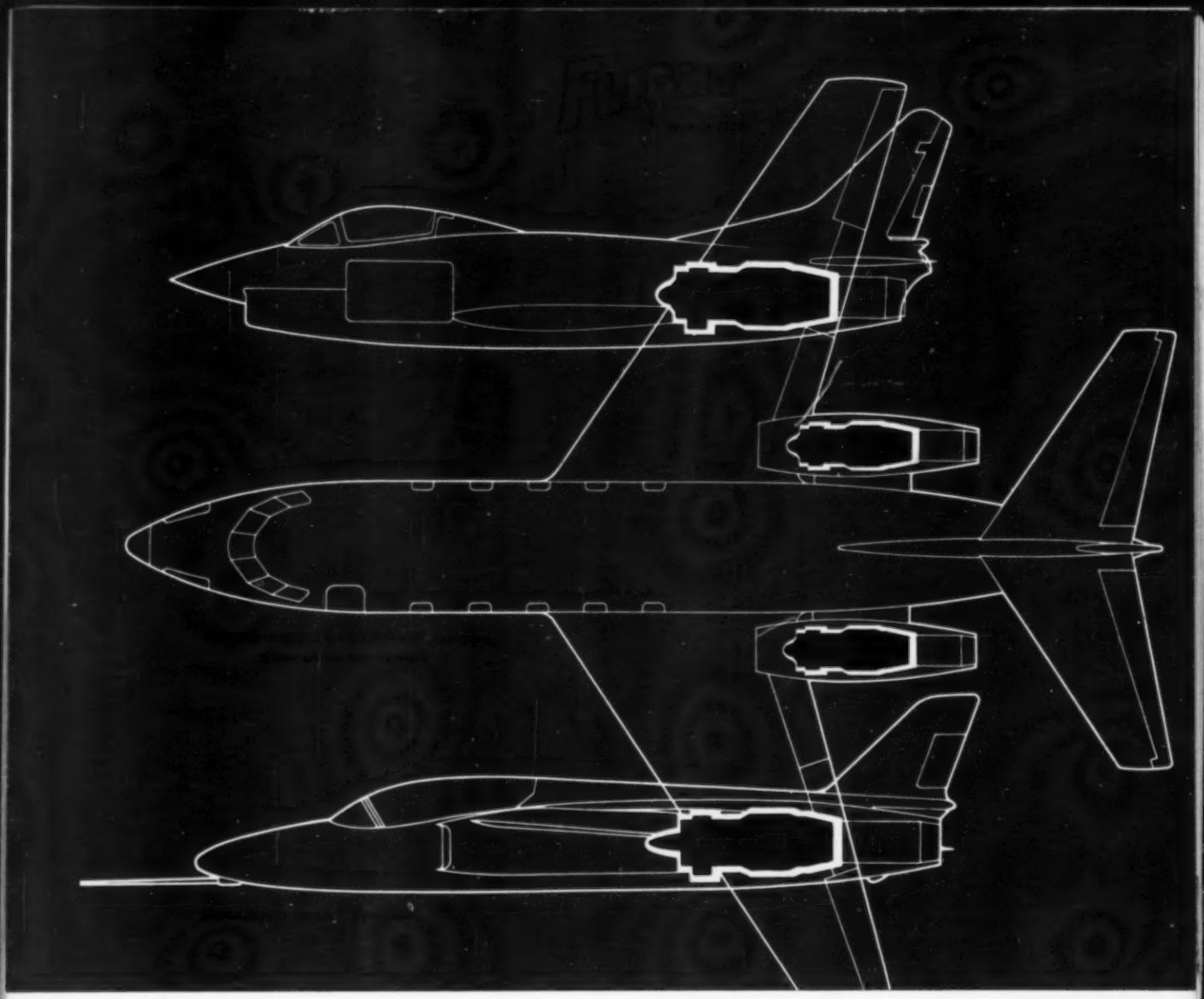

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